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OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

BY MONS. DE FONTENELLE.

WITH NOTES BY RICHARD A. PROCTOR.

[I have received many inquiries in regard to the earliest history of the study of life in other worlds, and am surprised to find how little is known of the work of Huyghens, Fontenelle, and others, in that direction. It has occurred to me, in particular, that the bright and graceful little treatise of Fontenelle, published early in the eighteenth century, (written as it was at a time when the Vortices of Descartes were in full vogue in his own country, though beginning to be discredited in the country of the great Newton) would be interesting and new to thousands of our readers. I propose, therefore, to give an English version of the little book here, with such notes of my own as may seem necessary and desirable. The quaint old illustrations are given; those illustrating the vortices are indeed necessary to give an idea of the old notions respecting these celestial whirlpools.—RICHARD A. PROCTOR.]

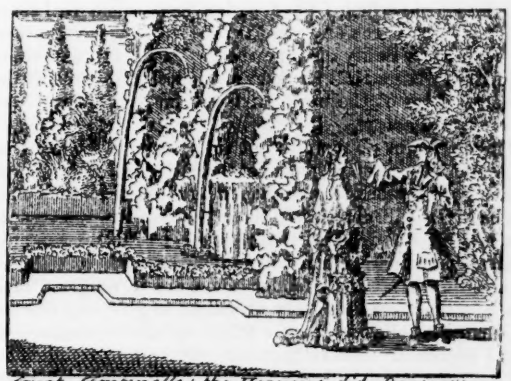
FONTENELLE'S PREFACE.

I AM pretty much in the same case with Cicero, when he undertook to write of philosophical matters in the Latin tongue, there being, then, no books upon that subject but what were in Greek. He was told that such an attempt would be useless, because those who were lovers of philosophy would rather take the pains to search for it in Greek writers than make use of Latin ones, which treated of it, but at second hand; and that those who had no relish for this science would never trouble their heads with either Greek or Latin. To these objectors, he answered, it would happen quite otherwise; for, says he, the great ease people will find in reading Latin books will tempt those to be philosophers who are none, and they who already are philosophers by reading Greek books will be very glad to see how the subject is handled in Latin.

Cicero might with good reason answer as he did, because the excellency of his genius and the great reputation he had acquired warranted the success of all he wrote; but in a design not much unlike his I am far from having those grounds of confidence which he had. My purpose is to discourse of philosophy, but not directly in a philosophical manner, and to raise it to such a pitch that it shall not be too dry and insipid a subject to please gentlemen, nor too mean and trifling to entertain scholars. Should I be told (as Cicero was) that such a discourse as this would not please the learned, because it cannot teach them anything; nor the illiterate, because they will have no mind to learn; I will not answer as he did. It may be endeavouring to please everybody; I have pleased nobody. Now, to keep a medium betwixt two extreams is so very difficult that I believe I shall never desire to put myself a second time to the like trouble.

If I should acquaint those who are to read this book, and have any knowledge of natural philosophy, that I do not pretend to instruct, but only to divert them; by presenting to their view, in a gay and pleasing dress, what they have already seen in a more grave and solid habit. Not but they to whom the subject is new may be both diverted and instructed. The first will act contrary to my intention if they look for profit, and the last if they seek for nothing but pleasure.

I have chosen that part of philosophy which is most likely to excite curiosity; for I think nothing concerns us more than to enquire how this world which we inhabit is made; and whether there be any other worlds like it which are also inhabited as this is. But, after all, it is at everybody's discretion how far they will run their disquisitions. Those who have any thoughts to lose may throw them away upon such subjects as these, but I suppose such as can employ their time better will not be at so vain and fruitless an expense.



Great Fontenelle: the Heavens did Descry,
And taught the Ladies his Philosophy.

In these discourses I have introduced a lady, to be instructed in things of which she never heard; and I have made use of this fiction to render the book the more exceptable, and to give encouragement to gentlewomen by the example of one of their own sex, who, without any supernatural parts or tincture of learning, understands what is said to her; and, without any confusion, rightly apprehends what vortexes and other worlds are. And why may not there be a woman like this imaginary Marchioness, since her conceptions are no other than such as she could not chuse but have?

To penetrate into things either obscure in themselves, or but darkly expressed, requires deep meditation, and an earnest application of the mind! but here, nothing more is requisite than to read and imprint an idea of what is read

in the fancy, which will certainly be clear enough. I shall desire no more of the fair sex, than that they will peruse this system of philosophy, with the same application that they do a romance or novel, when they would retain the plot, or find out all its beauties. It is true, that the ideas of this are less familiar to most ladies than those of romances, but they are not more obscure; for at most, twice or thrice thinking, will render them very perspicuous.

I have not composed an airy system, which has no foundation at all: I have made use of some true philosophical arguments, and of as many as I thought necessary; but it falls out very luckily in this subject, that the physical-ideas are in themselves very diverting; and as they convince and satisfy reason, so at the same time they present to the imagination a prospect which looks as if it were made on purpose to please it.

When I meet with any fragments which are not of this kind, I put them into some pretty strange dress: Virgil has done the like in his "Georgicks;" when his subject is very dry, he adorns it with pleasant digressions: Ovid has done the same in his "Art of Love;" and though his subject be of itself very pleasing, yet he thought it tedious to talk of nothing but love. My subject has more need of digressions than his, yet I have made use of them very sparingly, and of such only, as the natural liberty of conversation allows: I have placed them only where I thought my readers would be pleased to meet with them; the greatest part of them are in the beginning of the book, because the mind cannot at first be so well acquainted with the principal ideas which are presented to it; and, in a word, they are taken from the subject itself, or as near to it as is possible.

I have related nothing concerning the inhabitants of the several worlds which may seem fabulous or chimerical; but have said whatever may be reasonably thought of them; and the visions which I have added have some real foundation; what is true and what is false are mingled together, but so as to be easily distinguished. I will not undertake to justify so fantastical and odd a composition, which is the principal point of the work, and yet for which I can give no very good reason.

There remains no more to be said in this place to a sort of people who, perhaps, will not be easily satisfied, though I have good reasons to give them; but that the best which can be given will not satisfy them. These are the scrupulous persons who imagine that the placing inhabitants anywhere but upon the earth will prove dangerous to religion. I know how excessively tender some are in religious matters, and therefore I am very unwilling to give any offence, in what I publish, to people whose opinion is contrary to that I maintain. But religion can receive no prejudice by my system, which fills an infinity of worlds with inhabitants, if a little error of the imagination be but rectified. When it is said the moon is inhabited, some presently fancy that there are such men there as ourselves; and priests, without any more ado, think him an Atheist who is of that opinion. None of Adam's posterity, cry they, ever travelled so far as the moon; nor were any colonies ever planted in that region. I grant it. The men in the moon are not the sons of Adam. And here again theology would be puzzled if there should be men anywhere who never descended from him. To say no more, this is the great difficulty to which all others may be reduced; to clear it by a larger explanation, I must make use of terms which deserve greater respect than to put into a treatise, so far from being serious as this is. But perhaps there is no need of answering the objection, for it concerns nobody but the men in the moon; and I never yet affirmed there are men there. If any ask what the inhabitants are, if they be not men? all I can say is that I never saw them; and it is not because I have seen them that I speak of them. Let none, however, think that I say there are no men in the moon purposely to avoid the objection made against me, for it appears it is impossible there should be any men there, according to the idea I have framed of that infinite diversity and variety, which is to be observed in the works of nature. This idea runs through the whole book, and cannot be contradicted by any philosopher. Nay, I believe I shall only hear this objection started by such as shall speak of these discourses without having read them. But is this a point to be depended on? No, on the contrary, I should more probably fear that the objection might be made to me from many passages.

FONTENELLE.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

BY EDWARD CLODD.

IV.

THE artificial divisions which man in his pride of birth made between the several classes of phenomena in the inorganic world, and also between the inorganic and the organic, are being swept away before the larger knowledge and insight of our time. Indeed, it would seem that the surest test we can apply to the worth of any kind of knowledge is whether it adds to or takes from our growing conception of unity. If it does the former, we cannot overthrow it; if it does the latter, then is it science "falsely so called."

That notable doctrine known as the correlation of physical forces, or the convertibility into one another of heat, light, electricity, chemical affinity, &c., each being a mode of manifestation of an unknown energy which "lives through all life, extends through all extent," has its counterpart in the correlation of spiritual forces. Varied as are the modes of expression of these, that variety is on the surface only. Deep down lies the one source that feeds them, the one heart to whose existence their pulsations witness. All primitive philosophies, all religions "that man did ever find," are but as the refractions of the same light dispersed through different media; are the result of the speculations of the same subject, allowances being made for what the astronomers call personal equation, upon like objects. And, therefore, in treating of the nature and limitations of man's early thought concerning his surroundings, whether these be the broad earth bathed in the sunshine, or swathed in the darkness, or the sounds that come from unseen agents, the sight of spectral visitants of whom he cannot have touch, and out of which are built up his theories of the invisible world; the reader may find reference to the same conditions which were shown in former papers to give birth and sustenance to primitive myth. The same fantastic conclusions, drawn from rude analysis and associations, and from seeming connections of cause and effect; the same bewildering entanglement between things which we know can have nothing in common, meet us; and the same scientific method by which is determined the necessary place of each in the advance of man to truth through illusion is applied.

The illustrations of the vital connection which the savage assumes between himself and his name show how easy is the passage from belief in life inhering in everything, to belief in it as capable of power for good or evil. This can be shown by illustrations from more tangible

things than names. The savage who is afraid to utter these, shrinks from having his likeness taken, in the feeling that some part of him is transferred, and at the mercy of the sorcerer and enemy. The Malemutes of North America refused to risk their lives before a photographic apparatus. They said that those who had their likenesses, had their spirit, and they would not let these pass into the keeping of those who might use them as instruments of torment. The Yanktons accused Catlin of causing a scarcity of buffaloes by putting a great many of them in his book, and refused to let him take their portraits. So with the Araucanians, who ran away if any attempt was made to sketch them. Among such races, we find great care exercised lest cuttings of hair, parings of nails, saliva, refuse of food, water in which they had washed, &c., should fall into unfriendly or mistrusted hands. The South Sea Island chiefs had servants following them with spittoons, that the saliva might be buried in some hidden place. Among the Polynesians any one who fell ill attributed it to some sorcerer, who had got hold of refuse from the sick and was burning it, and the quiet of the night was often broken by the blowing of shell-trumpets, as signals for the sorcerer to stop until the gifts on their way to appease him could arrive. As with the name or the portrait, whoever possessed a part of the material substance possessed a part of the spiritual, and in this world-wide belief in a sympathetic connection between things living and not living lies the whole philosophy of sorcery, of charms, amulets, spells, and the general doctrine of luck surviving through the successive stages of culture to this day. And he who would prevent anything from his person getting into hostile hands, naturally sought after things in which coveted qualities were believed to dwell, and avoided those of a reverse nature. So we find tiger's flesh eaten to give courage, and the eyes of owls swallowed to give good sight in the dark. The Kaffirs prepare a powder made of the dried flesh of various wild beasts, the leopard, tiger, elephant, snake, &c., so as to absorb the several virtues of these creatures. The Tyrolese hunter wears his tuft of eagle's down to gain long sight and daring, and the Red Indian strings bears' claws round his neck to get Bruin's savage courage. The customs of scalping and, in some measure, of cannibalism, may be referred to the same notion, for the Red man will risk his life to prevent a tribesman's scalp being captured by the foe, and the New Zealander will swallow the eyes of his slain enemy to improve his sight. When a whaler died, the Eskimos distributed portions of his dried body among his friends, and rubbed the points of their lances with them, it being held that a weapon thus charmed would pierce a vital part in a whale, where another would fail. Sometimes the body was laid in a cave, and, before starting for the chase, the whalers would assemble, and, carrying it to a stream, plunge it in, and then drink the water. When the heroic Jesuit, Brébeuf, was tortured by the Iroquois, they were so astonished at his endurance, that they laid open his breast and came in a crowd to drink the blood of so valiant a foe, thinking to imbibe with it some portion of his courage. A chief tore out his heart and devoured it.

Cannibalism, it may be remarked, *en passant*, is also found to have a religious significance, on the supposition, which has unsuspected survival among advanced races, that eating the body and drinking the blood communicates the spirit of the victim to the consumer. It is not always the most savage races who practise it; for example, the Australians, despite the scarcity of large animals for food supply, rarely eat the flesh of man, whilst the New Zealanders, who rank far above them, and had not the like excuse, were systematic feeders on human flesh.

As examples of a reverse kind, but witnessing to the play of like beliefs in qualities passing from brutes and lifeless things, we find some races avoiding oil, lest the game slip through their fingers, and abstaining from the flesh of deer, lest it engenders timidity, and of pigs and of tortoises, lest the eater has very small eyes. Dr. Tylor gives an apposite illustration of a kindred superstition in the Hessian lad who thinks that he may escape the conscription by carrying a baby-girl's cap in his pocket, as a symbolical way of repudiating manhood. Among ourselves there was an old medical saw, "Hare-flesh engendereth melancholy bloude," and in Swift's "Polite Conversation" we have this reason assigned by Lady Answerall when asked to eat it; whilst faith is not yet extinct in the "Doctrine of Signatures," or the notion that the appearance of a plant indicates the disease for which it is a remedy, as the "eyebright," the black-purple spot on the corolla of which was said to show that it was good for weak eyes.

Brand remarks* that the custom of giving infants coral to help in cutting the teeth, is said to be a survival of an old belief in it as an amulet; and in English, Sicilian, and West Indian folk-lore, we find the belief that it changes colour in sympathy with the pale or healthy look of the wearer. An old Latin author says: "It putteth of lightenynge, whirlewynde, tempeste, and stormes fro shyppes and houses that it is in."

We are each of us hundreds of thousands of years old, and although our customs and beliefs have a far less venerable antiquity, their sources lie not less in primitive thought. Like the survival of the "casula" or "little house" or "shelter" in the chasuble of the priest; like the use of stone knives in circumcision long after the discovery of metals; the general tends to become special; the common, its primitive need or service forgotten, to become sacred. Sometimes the early idea abides; the Crees, who carry about the bones of the dead carefully wrapped up as a fetish; the Caribs, who think such relics can answer questions; the Xomanes, who drink the powdered bones in water, that they may receive the spirit; the Iroquois cited above; represent the barbarous ancestry of higher races, whether of the Bacchanalians described by Arnobius, who thought that the fulness of the divine majesty was imparted to them when they tore and ate the struggling rams with mouths dripping with gore, or of the faithful who receive nutriment through the symbols of the Cross. And the prayers of savage and civilised have this in common, that some advantage is thereby sought by the utterer; their sacrifices are alike the giving up of one's goods or one's self to a deity who may be appeased or bribed thereby; their fastings are cultivated as inducing the abnormal states in which their old men dream dreams and their young men see visions, spirits appearing as angels ascending and descending between earth and the abode of the blest; their baptisms are the ancient lustrations, which water, as the cleansing element, suggested; and their eastward position, over which jurists and ecclesiastics have fought, the undoubted relic of worship of the rising sun.

In short, there is no rite or ceremony yet practised and revered amongst us which is not the lineal descendant of barbaric thought and usage, expressing a need which, were men less the slaves of creation and indolence, would long since have found loftier form than in genuflexion before shrine and reliquary. By an exercise of imagination not possible but for these being a felicitous "gesture language" of the cries of human souls, a mass of heathen and pagan rites have been transformed into those of the Christian

* "Pop. Ant.," II., 85.

XUM

faith. That they have come to be mistaken for the ideas symbolised; that with the loftiest spiritual teaching there should remain commingled belief in miraculous power in fragments (mostly spurious) of dead men and their clothes; only shows the persistency of that notion of a vital connection between the lifeless and the living which this paper has sought to illustrate.

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE MIDDLE DEPTHS (*continued*).

THE larvæ of these two great water-beetles are elongate, six-footed creatures, with powerful jaws (Fig. 1), presenting no sort of resemblance to the beetles themselves; both are carnivorous and extremely voracious, dealing destruction to great numbers of their companions in pond-life. The ordinary spiracles being aborted, their respiration is conducted through certain projections at the tip of the tail, which are thrust above the surface to imbibe air. Having passed a comparatively short life in the larval condition, the insect quits the water, and, forming a cell in the damp margins of the pond, there effects its change to the pupal state. In due time the beetle is produced from this,

Fig. 1.—Larva of Hydrophilus piceus.

at first soft and pale, but acquiring, after a few days' exposure to the air, its normal colour and consistency. The female Hydrophilus forms a marvellous sac for the reception of her eggs. It is composed of a gummy substance, the secretion of which is effected not in or near the mouth, but at the other end of the alimentary canal. A tough, papery bag is formed, which carries a long spike, and is attached to subaqueous plants. The eggs, about fifty in number, are regularly placed side by side within this, and are thus protected from the attacks of such aquatic creatures as might feel disposed to try the taste of beetles' eggs.

Another of the Philhydrida, a much smaller insect, of yellowish-brown colour, called *Spercheus emarginatus* (Fig. 2), which used to be found at Whittlesea Mere, and was supposed by many to have become extinct as a British species until recently rediscovered by Mr. T. R. Billups at a certain spot in the neighbourhood of South London, forms

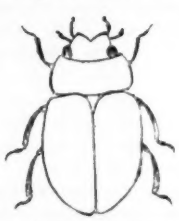


Fig. 2.—Spercheus emarginatus.

a bag which the mother carries about on the under surface of her body. This insect, both in the larval and perfect state, is described by the Rev. W. W. Fowler, who has kept and watched the species, as having the peculiar habit of walking on the under-side of the surface of the water with its back downwards, after the fashion of a fly on a ceiling, a thin film of air contained between the body and the edges of the elytra seeming to act as a float; the larva, too, is so completely permeated with air by means of its large tracheæ as to be rendered quite buoyant, and to find, apparently, as much difficulty in sinking as a man with a cork jacket on; so it needs no effort to maintain itself in its inverted position just below the surface.

Water-beetles, as we have already said, are not confined to the water, but at night frequently leave their native ponds and enjoy themselves in the air, or migrate to other quarters. No collection of water is so small as not to prove attractive to them; even cart-ruts that have been converted into so many miniature canals by a heavy rain may soon become tenanted. They cannot boast of any great brilliance of colouring. Yellows of no very conspicuous hue, browns, greys and blacks, singly or intermixed, are the prevailing tints. Some few of the brighter yellow species are spotted with black, and so become rather pretty, and some of the Philhydrida are slightly adorned with spots and patches of a metallic tint something like that of "peacock copper ore," but with these few exceptions they are a sombre set of insects, and their chief interest certainly lies in the remarkable modifications which fit them for aquatic life.

We now pass to the Dipterous fauna of the middle depths. The Diptera, it will be remembered, are the two-winged flies, and none of these in the perfect state inhabit water; some, however, are aquatic during their two earlier stages. Omitting a few very aberrant forms, there may be considered to be two very distinct types of flies, one slender, with abnormally long and fragile legs, and with antennæ of moderate length, and frequently tufted or fringed with hairs; the other stouter and more substantial, with much shorter legs, and antennæ so inconspicuous as often to be unnoticed. It is to the former of these groups that most of the species whose larvæ are aquatic belong. They consist of certain kinds of gnats, midges, and daddy-longlegs, insects whose *names* are as familiar as household words, though no very exact signification appears to be popularly attached—at any rate to the two former of these, which are often vaguely used for any minute and delicate flying insect, of whatever nature. Very varied are the habits of the long-legged, long-horned flies; some of them are the causes of certain gall-like excrescences that occasionally disfigure plants, and inside which their larvæ live; the larvæ of others, again, live in the earth, especially in damp places, and it is only a few members of the group that are aquatic, and that we have now to deal with.

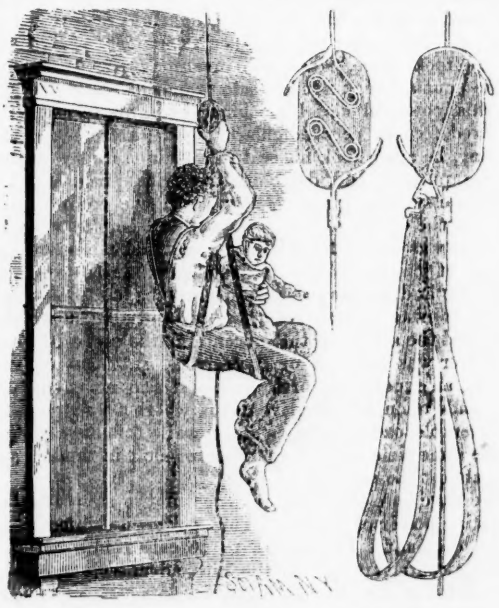
It may seem difficult to conceive of a method by which so fragile a creature as a gnat, which would be irretrievably damaged by contact with the water, can manage safely to convey its eggs into such a position as will permit the larvæ hatched from them at once to get into their proper element. Most wonderful, indeed, is the plan adopted. Finding some floating shred of straw, stick, grass, or other such support, the expectant mother rests her two fore-legs on this, allows the next pair gently to touch the water, and crosses the third pair behind to form a sort of vice in which to hold the eggs as they are deposited. Then a long oval egg is lodged in the angle formed by the crossed legs, with its longer diameter vertical; another, following it, is glued on to the side of the first in a similar position, and so on till some 200 or 300 are fastened into a sort of raft, or rather life-boat, as the mass is curved upwards at each end. Then the little vessel is abandoned to the mercy of winds and wavelets, and so floats about for a few days, benefiting by sun and air, till the growing embryos, finding their quarters too close, push open a kind of trap-door in the floor of the egg and take a dive at once into their watery home. They are quaint-looking creatures, with a big head

and thorax and long, tapering body, and they swim about head downwards. Near the tail, a straight branch, carrying a number of hairs at its tip, projects at an angle with the body. This is a respiratory tube, and communicates both with the outer air at its tip, and with the tracheal system at its base. All that is necessary for breathing, therefore, is that the tip of this tube should be above the surface. Accordingly, when at rest, the larva takes up this position, while at other times it goes wriggling about through the water, being of sufficient buoyancy to rise without effort to the surface when occasion demands. After several changes of skin the pupal stage is reached, and the last moult is accompanied by a remarkable alteration in the appearance of the insect. The head and thorax now appear as if thrown into one large mass, from which the body tapers away. But the most astonishing change of all is that which takes place in the respiratory system; the entrance to this is now transferred to the opposite end of the body, and appears as two small twisted horns projecting from the gigantic head. If now the insect were to retain its inverted position, there would obviously be no possibility of bringing these breathing horns nearer the air than a whole body's length; therefore, it turns a somersault in the water, and henceforth goes about head uppermost, an attitude which, when it is at the surface, brings the organs in question just above the water. Though the creature is now a pupa, and can take no nourishment, it is possessed of almost as much freedom of motion as before, and jerks itself about by vigorous wrigglings of its awkward form.

(*To be continued.*)

A NOVEL FIRE-ESCAPE.

THE sides of the block are united by four friction pins, arranged on two diagonal lines, and over which the rope or wire is passed (as clearly shown in the engraving).



The rope is also passed over pins at the top and bottom of the block. At each end of the block is pivoted a brake lever, the inner ends of which press the rope against the pins. On a rod secured to one of the outer side surfaces of the block runs a traveller, to which one end of a belt of leather or webbing is secured, the other end of the belt being provided with a hook to be passed over the rod.

To use the escape, one end of the rope is hooked in the window-sill, and the other end thrown out of the window. The belt is passed round the body, and the hook clasped over the side rod. Then the person steps out of the window and slides slowly down the rope, the friction pins in the block preventing a rapid descent. By means of the brake levers the apparatus can be stopped at any time. When the block arrives at the ground, the person unfastens the belt, and the block is pulled up again to be used by another person, who throws the end of the rope that had been fastened in the room out of the window, and secures the opposite end. The device is portable, takes up a small space in a gripsack, and weighs but little.

This invention has been patented by Messrs. David Ware and C. W. Richman, of Philadelphia, Pa.—*Scientific American.*

NOTES ON FLYING AND FLYING-MACHINES.

BY RICHARD A. PROCTOR.

(*Continued from page 4.*)

BUT although the reasoning of Borelli suffices perfectly well to show that man can never fly by attaching pinions to his arms, and flapping these in imitation (however close) of a bird's action in flying, it by no means follows that man must be unable to fly when the most powerful muscles of his body are called into action to move suitably-devised pinions. M. Besnier made a step in this direction (towards the close of the last century) when he employed, in his attempts to fly, those powerful muscles of the arm which are used in supporting a weight over the shoulder (as when a bricklayer carries a hod, or when a countryman carries a load of hay with a pitchfork). But the way in which he employed the muscles of the leg was less satisfactory. In his method, a long rod passed over each shoulder, folding pinions being attached to both ends of each rod. When either end of a rod was drawn down, the descending pinion opened, the ascending pinion at the other end closing; and the two rods were worked by alternate downward pulls with the arms and legs. The downward pull with the arms was exceedingly effective; but the downward pull with the legs was altogether feeble. For the body lying horizontally, the muscles used in the downward pull with the legs were those by which the leg is carried forward in walking, and these muscles have very little strength, as any one will see who, standing upright on one leg, tries, without bending the knee of the other, to push forward any considerable weight with the front of this leg.

Yet even with this imperfect contrivance Besnier achieved a partial success. His pinions did not, indeed, serve to raise him in the air; but when, by a sharp run forward, he had brought that aërial supporting power into action of which we have spoken above, the pinions, sharply worked, so far sustained him as to allow him to cross a river of considerable width. It is not unlikely that, had Besnier provided fixed sustaining surfaces, in addition to the movable pinions, he might have increased the distance he could traverse. But, as regards flight, there was a further and much more serious defect in his apparatus. No means whatever were provided for propulsion. The wings tended to raise the body (this tendency only availing, however, to sustain it); but they could give no forward motion. With

a slight modification, it is probable that Besnier's method would enable an active man to travel over ground with extreme rapidity, clearing impediments of considerable height, and taking tolerably wide rivers almost "in his stride"; but I believe that the method could never enable men actually to fly.

It may be remarked, indeed, that the art of flying, if it is ever attained, will probably be arrived at by means of attempts directed, in the first place, towards rapid passage along *terra firma*. As the trapeze gymnast avails himself of the supporting power of ropes, so the supporting power of the air may be called into action to aid men in traversing the ground. The following passage from Turnor's *Astra Castra* shows that our velocipedists might soon be outvied by half-flying pedestrians: "Soon after Bacon's time," he tells us, "projects were instituted to train up children from their infancy in the exercise of flying with artificial wings, which seemed to be the favourite plan of the artists and philosophers of that day." If we credit the accounts of some of these experiments, it would seem that considerable progress was made that way. The individuals who used the wings could skim over the surface of the earth with a great deal of ease and celerity. This was accomplished by the combined faculties of running and flying. It is stated that, by an alternate continued motion of the wings against the air, and the feet against the ground, they were enabled to move along with a striding motion, and with incredible speed.

A gymnast of our own day, Mr. Charles Spencer ("one of the best teachers of gymnastics in this country," says Mr. Brearey), has met with even more marked success, for he has been able to raise himself by the action of wings attached to his arms. The material of which these wings were made was too fragile for actual flight; and Mr. Spencer was prevented from making strong efforts because the wickerwork to which the apparatus was attached, fitting tightly round his body, caused pain, and obstructed his movements. Yet he tells us that, running down a small incline in the open air, and jumping from the ground, he has been able, by the action of the wings, to sustain flight for a distance of 120 feet; and when the apparatus was suspended in the transept of the Crystal Palace (in the spring of 1868), he was able, as we have said, to raise himself, though only to a slight extent, by the action of the wings. It should be remarked, however, that his apparatus seems very little adapted for its purpose, since the wings are attached to the arms in such sort that the weak breast-muscles are chiefly called into play. Borelli's main objection applies in full to such a contrivance; and the wonder is that Mr. Spencer met with even a partial success. One would have expected rather that the prediction of a writer in the *Times* (calling himself Apteryx, or the Wingless) would have been fulfilled, and that the "aëronaut, if he flapped at all, would come to grief, like the sage in 'Rasselas,' and all others who have tried flying with artificial wings."

The objection founded on the relative weakness of the muscles of man as compared with those of birds (without reference to the question of adaptation), seems at first sight more serious. Although there can be little question that the superior strength of the muscles of birds has been in general enormously exaggerated, yet such a superiority undoubtedly exists to some degree. This gives the bird a clear advantage over man, insomuch that man can never hope by his unaided exertions to rival the bird in its own element. It by no means follows, however, that because man may never be able to rival the flight of the eagle or the condor, of the pigeon or the swallow, he must therefore needs be unable to fly at all.

It should be remembered, also, that men can avail themselves of contrivances by which a considerable velocity may be acquired at starting; and that when the aëronaut is once launched with adequate velocity, a comparatively moderate exertion of force may probably enable him to maintain that velocity, or even to increase it. In this case, a moderate exertion of force would also suffice to enable him to rise to a higher level. To show that this is so, we need only return to the illustration drawn from the kite. If a weight be attached to a kite's tail, the kite, which will maintain a certain height when the wind is blowing with a certain degree of force, will rise to a greater height when the force of the wind is but slightly increased.

Kites afford, indeed, the most striking evidence of the elevating power resulting from the swift motion of an inclined plane through the air, the fact being remembered always that, whatever supporting and elevating power is obtained when air moves horizontally with a certain velocity against an inclined plane, precisely the same supporting and elevating power will be obtained when the inclined plane is drawn or propelled horizontally with equal velocity through still air. Now the following passages from the "History of the Char-volant," or kite-carriage, bear significantly upon the subject we are now upon. The kite employed in the first experiments (made early in the present century) had a surface of fifty-five square feet. "Nor was less progress made in the experimental department when large weights were required to be raised or transposed. While on this subject, we must not omit to observe that the first person who soared aloft in the air by this invention was a lady, whose courage would not be denied this test of its strength. An arm-chair was brought on the ground, then, lowering the cordage of the kite by slackening the lower brace, the chair was firmly lashed to the main-line, and the lady took her seat. The main-brace being hauled taut, the huge buoyant sail rose aloft with its fair burden, continuing to ascend to the height of a hundred yards. On descending, she expressed herself much pleased with the easy motion of the kite and the delightful prospect she had enjoyed. Soon after this another experiment of a similar nature took place, when the inventor's son successfully carried out a design not less safe than bold—that of scaling by this powerful aërial machine the brow of a cliff two hundred feet in perpendicular height. Here, after safely landing, he again took his seat in a chair expressly prepared for the purpose, and, detaching the swivel-line which kept it at its elevation, glided gently down the cordage to the hand of the director. The buoyant sail employed on this occasion was thirty feet in height, and had a proportionate spread of canvas. The rise of the machine was most majestic, and nothing could surpass the steadiness with which it was manœuvred, the certainty with which it answered the action of the braces, and the ease with which its power was lessened or increased. . . . . Subsequently to this, an experiment of a very bold and novel character was made upon an extensive down, where a waggon with a considerable load was drawn along, while this huge machine at the same time carried an observer aloft in the air, realising almost the romance of flying."

We have here abundant evidence of the supporting and elevating power of the air. This power is, however, in a sense, dormant. It requires to be called into action by suitable contrivances. In the kite, advantage is taken of the motion of the air. In flight, advantage must be taken of motion athwart the air, this motion being, in the first place, communicated while the aëronaut or flying-machine is on the ground. Given a sufficient extent of supporting surface, and an adequate velocity, any body, however heavy, may be made to rise from the ground; and there can be no

question that mechanicians can devise the means of obtaining at least a sufficient velocity of motion to raise either a man or a flying machine, provided with no greater extent of supporting surface than would be manageable in either case. It is not the difficulty of obtaining from the air *at starting* the requisite supporting power that need deter the aëronaut. The real difficulties are those which follow. The velocity of motion must be maintained, and should admit of being increased. There must be the means of increasing the elevation, however slowly. There must be the means of guiding the aëronaut's flight. And lastly, the aëronaut or the flying-machine must fly with well-preserved balance—the supporting power of the air depending entirely on the steadiness with which the supporting surfaces traverse it.

I believe that these difficulties are not insuperable; and not only so, but that none of the failures recorded during the long history of aëronautical experiments need discourage us from hoping for eventual success. Nearly all those failures have resulted from the neglect of conditions which have now been shown to be essential to the solution of the problem. Nothing but failure could be looked for from the attempts hitherto made; and, indeed, the only wonder is that failure has not been always as disastrous as in the case of Cocking's ill-judged descent. If a man who has made no previous experiments will insist on jumping from a summit of a steeple, with untried wings attached to his arms, it cannot greatly be wondered at that he falls to the ground and breaks his limbs, as Allard and others have done. If, notwithstanding the well-known weakness of the human breast-muscles, the aëronaut tries to rise by flapping wings like a bird's, we cannot be surprised that he should fail in his purpose. Nor, again, can we wonder if his attempts to direct balloons from the car should fail, when we know the car could not even be drawn with ropes against a steady breeze without injury to the supporting balloon. And we need look no further for the cause of the repeated failures of all the flying-machines yet constructed, than to the fact that no adequate provision has yet been made to balance such machines, so that they may travel steadily through the air. It seems to have been supposed that if propelling and elevating power were supplied the flying-machine would balance itself; and, accordingly, if we examine the proposed constructions, we find that in nine cases out of ten (if not in all) the machine would be as likely to travel bottom-upwards as on an even keel. The common parachute (which, however, is not a flying-machine) is the only instance I can think of in which a non-buoyant machine for aërial locomotion has possessed what is called a "position of rest."

Perhaps the gravest mistake of all is that of supposing that, on a first trial, a man could balance himself in the air by means of wings. Placed, for the first time, in deep water, man is utterly unable to swim, and if left to himself will inevitably drown; although a very slight and very easily-acquired knowledge of the requisite motions will enable him to preserve his balance. And yet it seems to have been conceived by most of those who have attempted flight, that when first left to himself in open air, with a more or less ingeniously-contrived apparatus attached to him, a man would not only be able to balance himself in that unstable medium, but also to resist the down-drawing action of gravity (which scarcely acts at all on the swimmer), and wing his way through the air by a series of new and untried movements!

It encourages confidence in the attempts now being made to solve the problem of aërial locomotion, that they are tentative—founded on observation and experiment, and not on vague notions respecting the manner in which birds fly. Fresh experiments are to be made, more particularly on the supporting power of the air upon bodies of different form, moving with different degrees of velocity. These experiments are under the charge of Messrs. Browning and Wenham, of the Aëronautical Society, whose skill in experimental research, and more particularly in inquiries depending on mechanical considerations, will give a high value to their deductions. The question of securing the equipoise of flying-machines has also received attention; and it is probable that the principle of the instrument called the gyroscope will be called into action to secure steadiness of motion, at least in the experimental flights. What this principle is need not here be scientifically discussed; but it may be described as the tendency of a rotating body to preserve unchanged the direction of the axis about which the body is rotating. The spinning-top and the quoit (well thrown) afford illustrations of this principle. The peculiar flight of a flat missile, already referred to, depends on the same principle; for the flight only exhibits the peculiarities mentioned when the missile is caused to whirl in its own plane. But the most striking evidence yet given of the steadying property of rotation is that afforded by the experiments of Professor Piazzi Smyth, the Astronomer Royal for Scotland. During the voyage to Teneriffe (where, it will be remembered, his well-known Astronomer's Experiment was carried out), he tested the power of the gyroscope in giving steadiness, by causing a telescope to be so mounted, that the stand could not shift in position without changing the axial pose of a heavy rotating disc. The disc was set in rapid rotation by the sailors, and then the Professor directed the telescope towards a ship on the horizon. A fresh wind was blowing, so that everything on deck was swayed in lively sort by the tossing vessel; nor did the telescope *seem* a whit steadier—the motion of objects round it giving to the instrument an appearance of equal instability. But the officers were invited to look through the tube, and to their amazement, the distant ship was seen as steady in the middle of the telescopic field as though, instead of being set up on a tossing and rolling ship, the telescope had been mounted in an observatory on *terra firma*. The principle of the gyroscope has also been used for the purpose of so steadying the stand of a photographic camera placed in the car of a balloon, that photographs might be taken despite the tendency of the balloon to rotate. As applied to flying-machines, the gyroscope would require to be so modified in form that its weight would not prove an overload for the machine. This is practicable, because a flat horizontal disc, rotating rapidly, will support itself in the air if travelling horizontally forward with adequate swiftness. In other words, since travelling-machines *must* travel swiftly, the gyroscopic portion of the machine may be made to support itself.

It is this property of enforced rapidity of motion which renders the probable results of the mastery of our problem so important. It has been well remarked that two problems will be solved at once, when the first really successful flying-machine has been made—not only the problem of flight, but the problem of travelling more swiftly than by any contrivances yet devised. In the motion of a flying-machine, as distinguished from the flight of man by his own exertions, the swiftness of the bird's flight may be more than matched. It is a mere mechanical problem which has to be solved; and few mechanicians will deny that when once the true principles of flight have been recognised, the ingenuity of man is capable of constructing machines in which these principles shall be carried out. Iron and steam have given man the power of surpassing the speed of the swiftest of four-footed creatures—the horse, the greyhound, and the antelope. We have full

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confidence that the same useful servants place it in man's power to outvie in like manner the swiftest of winged creatures—the swallow, the pigeon, and the hawk.

THE TRICYCLES OF TO-DAY.

THE "CHEYLESMORE CLUB."

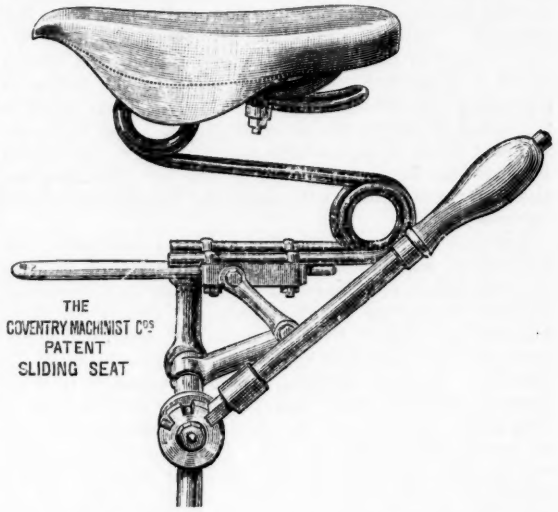
THE "Cheylesmore Club" is a very well-known type of a double-driving, rear-steering tricycle, and was, a season or two back, the general favourite of the London and large provincial clubs. It has, moreover, been largely supplied by the makers to many distinguished members of society. The frame is made of light steel tubing, and ball bearings are fitted to the driving and steering wheels, as well as the crank shaft, while the reputation of the Coventry Machinists' Company is a sufficient guarantee of the workmanship and high finish of the machine. The swan-like curved backbone, with little steering-wheel behind, gives it a very graceful appearance when in motion, causing it to contrast favourably with many front-steerers, which often put one so much in mind of perambulators and bath-chairs.

The machine, however, of late has lost some of its original prestige, which is traceable to two principal causes. The first reason may be readily accounted for by the great love of cycling novelty which is the inherent, ruling spirit of so many wheelmen, who are never satisfied unless they possess the "latest out," fancying, because there has recently been such a superabundance of animated discussion in numerous journals relating to improvements in tricycles, that the latest types of machines must of necessity possess great additional advantages over the older ones. The other reason, which has militated to a very great extent against its continued popularity, has been the frequent warning raised on all hands—"Don't, my dear fellow, have a rear-steering tricycle unless you wish to break your neck!"

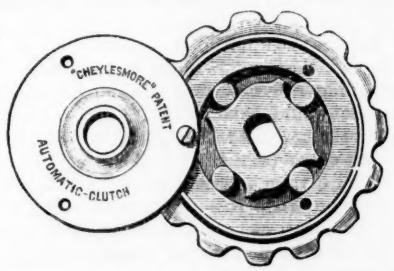
Now, undoubtedly the great majority of rear-steerers in the hands of careless or inexperienced riders are highly dangerous in descending hills, but the "Cheylesmore" is by no means to be classed in the same category. Not but what also there are other important exceptions of equally well-know rear-steerers which are in every way as safe as the "Cheylesmore," and with which I hope to deal in future papers. I may here state that I have ridden the "Cheylesmore" down exceedingly steep, stony, and rutty hills in Derbyshire, and on no single occasion have I come to grief. I remember quite well when first I rode the machine several friends of mine who ride front-steerers warned me to be very careful in descending hills, since the little wheel of rear-steerers was very apt to tip up, somewhat after the fashion the rear-wheel serves bicycle learners. But my machine has never served me so, although its backbone is several inches shorter than they are made this season, which alteration should certainly make them still steadier.

The makers now attach when specially ordered a patent sliding-seat to the machine (see illustration), the position of which the rider can alter backwards or forwards at pleasure, thus giving him the twofold advantage of being able to place his saddle directly over his pedals for hill climbing, or far back on the backbone when going down bank, in this manner preventing more than ever any slight tendency on the part of the machine either to swerve or tip up.

To my mind, one of the most pleasureable features of the machine is the patent automatic clutch action. The clutch gear, which is exceedingly simple, and never liable to get out of order, is fitted to the pedal-cranks, being connected by cogs and chains to the driving-wheels. It consists of a small toothed box, through which the crank-end passes without even coming into contact with it. The box, through which the crank passes, contains a small metal disc, which



has four hollows cut in its circumference, round at one end and angular at the other. In each of these cavities rides a small steel roller, which, on pedalling the crank forward, is jammed in the angular portion of the cavity, and thus pressed against the box, causing the wheel to rotate; but on pedalling backwards the ball is released, and runs round freely in the circular portion of the cavity. Its action, however, will be clearly seen by a reference to the accompanying illustration. By means, therefore,



of this simple contrivance the pedals remain perfectly stationary in descending hills, thus forming excellent foot-rests. It is decidedly advantageous to be able to use the pedals as foot-rests, since it enables the rider to cease pedalling on the smallest incline, his feet being ready for action when required, and no fear, as on other machines, of getting his ankles severally rapped in trying to replace his feet on swiftly-revolving pedals. It also empowers him to obtain a full leverage of the crank at any time he requires it, which proves very useful in climbing steep hills, by taking half-strokes. Some cyclists consider it a disadvantage, I know, at times not to be able to back pedal; but I have never found it so.

The machine is supplied with an excellent spoon break, which is sufficiently powerful to bring the machine to a dead stop on almost any incline, while the steering arrangement is everything that can be desired. On a good level road there are but few machines which can pass it, and it is by no means a slow or bad hill-climber. In fact, take the

"Cheylesmore" for all in all, I consider it a cheap, safe, pretty, comfortable, and, in the hands of a good rider, a fairly swift machine. F.

THE ELECTRO-MAGNET.

By W. SLINGO.

PRESUMABLY most readers are acquainted with the general features of an electro-magnet. It is, however, an instrument or tool capable of performing such wonderful dexterities, and of affording such a valuable insight into the principles of electricity, that a few brief remarks upon its structure and its uses may, it is thought, be welcome. Electricity is not such a young science but that most people know the electro-magnet to consist primarily of a coil or helix of insulated wire and a piece of soft iron, and that a current of electricity, in traversing the wire, renders the iron a magnet. For the benefit of the uninitiated, and in order to present a more continuous series of experiments and illustrations, a few lines may be advantageously devoted to the simpler fundamental features pertaining to the subject prior to venturing upon that portion of it which will be kept more prominently in view—viz., the best form to be adopted for a particular purpose, supplemented by directions for easily making and using the instrument. The two extremities of an ordinary steel magnet exhibit a difference in their behaviour, and are therefore in themselves different. Either end of a magnet attracts equally the same piece of unmagnetised iron, the difference being observable in the action of the ends or poles upon each other. Two magnetised sewing-needles suspended a few inches apart on water will, after a few seconds, assume parallel positions, the extremities pointing more or less north and south. If two of the similarly pointing ends be made to approach, repulsion ensues, while attraction results if the north-pointing end of one needle is placed sufficiently near to the south-pointing end of the other. To magnetise the sewing-needles, they may be drawn a few times over one of the poles of a magnet, always drawing in one direction, either from eye to point, or point to eye. The end of the needle which last touches the magnet becomes of opposite polarity to that of the end of the magnet used. Thus, if the north end of a magnet be used, and a needle passed over it a few times, beginning at the eye, then the point will be south (and the eye, of necessity, north). This follows as a matter of course, from the law that like polarities repel, and unlike attract, for we may easily conceive that the north makes itself evident at the eye (the part most remote from the magnet) in obedience to the repulsion by the north, and similarly that the point becomes south because of the closer proximity of the magnet-pole to the point than to the eye.

Suppose now that above or below a copper wire capable of carrying a current of electricity from two or three cells we suspend an unmagnetised needle at right angles with the copper wire. On passing the current, the needle will become a more or less powerful magnet, particularly if the wire is placed east to west, so that the needle is north to south, when the inductive effect exerted by the current is aided by the magnetism of the earth, that magnetism which caused the suspended magnetised needles to point north and south. If the needle be afterwards turned so as to point in some other direction, it will, when free, turn again to the north and south position, and will, in fact, assume all the properties of an ordinary magnet. Had the needle been an iron instead of a steel one, a different result would have followed. The iron would have been magnetised on the passage of the current, just as the steel was, only more powerfully. On the cessation of the current, however, its effect upon the iron needle would have instantly ceased, although the needle would continue in obedience to inertia and to the feeble influence of terrestrial magnetism to point north and south. The difference between iron and steel is further seen on moving the former into any other position than that of north and south. When this is done all trace of magnetisation is gone, and the iron exhibits no tendency to reassume the longitudinal direction. Had the iron been placed originally in any other than a north and south position it would not have felt, and, therefore, could not have retained the small effect produced by the magnetism of the earth.

So far as the magnetisation due to the current is concerned, it is quite immaterial whether the previously unmagnetised needle be placed in a longitudinal or any other direction whatever, so long as the current is made to cross it at right angles. It follows, obviously, that if we encircle a needle by a ring or loop of copper-wire, and send a current through the wire, the electricity in any one part of the circle conspires with or aids the current in every other portion. A proportionate increase in the intensity of magnetism naturally ensues. Carrying this principle a little farther, if, instead of one circular loop we employ several similar loops (wound round the needle in one constant direction, so that the current in traversing the wire is compelled to keep travelling from end to end without doubling back on itself) then the magnetising effect due to a single line or loop is proportionably multiplied. Again, if we employ two or more concentric loops, such as we should get, for example, by winding the wire in a manner similar to that of a watch-spring, we shall produce a corresponding increase. It is apparent, then, how proportionately great must be the effect produced by a current passing through a long coil composed of several layers, as compared with that resulting from the passage of the same current through a single wire at right angles to the needle.

The polarity which the needle assumes is dependent on the relative direction of the current. With a current passing over the needle from, say, south to north, the eye or the point, whichever it may be that is in the west, assumes a north polarity, while that extremity of the needle which lies to the east of the wire becomes a south pole. Generally, to adopt an illustration of Ampère's, assuming a little man to be swimming in the wire in the same direction as the current, and to have his face turned constantly towards the needle, that end will become north which is on his left hand. The same principle is involved here as in the case of galvanometers, and demonstrates the multiplying power of coils of wire.

When a soft iron wire is used instead of the steel needle, the effect produced by a current traversing the enveloping coil of wire ceases with the current, just as the effect produced by a current in a single length of wire was no longer felt when the current disappeared. Of the relation subsisting between the effective power of a single wire and a coil, more will be said presently.

Before we can predetermine the polarity an iron wire or rod will assume in response to the inductive effect exerted by a coil of wire, we must bear in mind that there are two ways of winding a coil, and that the electro-magnetic effects exerted by these two coils are opposite. This may be experimentally demonstrated with the aid of an iron rod such as, for want of something else, a clean poker, a yard or two of cotton-covered or other insulated wire (rather stout, say No. 16, B.W.G.), a magnetised sewing-

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needle, and two or three cells of, say, a bichromate battery. First, float the needle on a glass of water by laying it on a small piece of paper or cork. (If the hand and the needle are dry, the film of air adherent to or surrounding the needle will, generally speaking, prevent it from sinking.) Then, holding the handle of the poker and one end of the wire in the left hand, held out from the body, proceed to wind the wire over the other end of the poker with the right hand, moving the hand continuously in the same direction as that taken by the hands of a watch, as seen when looking at its face. In other words, taking the wire in the right hand, pass it from the upper side down the right side across the bottom, and back up the left side. In this way cover the square end of the poker with one layer or thickness of wire. Such a coil of wire is called a helix, and helices are divided into two classes—called right-handed and left-handed (according to the direction of winding). The helix just constructed and illustrated in Fig. 1

Fig. 1.

(depicting an iron rod, NS, inside of a piece of glass tubing, over which the wire is wound), is a left-handed one—a current on entering it at either end travelling through it in a direction opposite to that of the hands of a watch. To secure a right-handed helix (Fig. 2),

Fig. 2.

wind the wire round the poker from right to left, or move the hand in the opposite direction to that of the watch hands. The current in flowing through this helix travels in the opposite direction to that taken in the other, and, as we might anticipate, different causes produce different effects.

(To be continued.)

THE ANTARCTIC REGIONS.

BY R. A. PROCTOR.

(Continued from page 7.)

IT is singular how confidently geographers have spoken of the great Antarctic continent, when we remember that only an inconsiderable extent of coast line has even been seen by Anctarctic voyagers in any longitudes, except where Ross made his nearest approach to the South Pole. There is absolutely not a particle of evidence for believing that the ice-barriers which have been encountered—Sabine Land, Adélie Land, Victoria Land, and Graham Land—belong to one and the same land region. It is not, indeed, certain that all the mapped coast-line is correct—for it must not be forgotten that where Commodore Wilkes charted down a coast-line Ross found an open (or only ice-encumbered) sea, *and sailed there*.

Yet Dr. Jilek, in the "Text-book of Oceanography," in use in the Imperial Naval Academy of Vienna, writes thus confidently respecting the Antarctic continent:—"There is now no doubt," he says, "that around the South Pole there is extended a great continent, mainly within the polar circle, since, although we do not know it in its full extent, yet the portions with which we have become acquainted, and the investigations made, furnish sufficient evidence to infer the existence of such with certainty. This southern or Antarctic continent advances farthest in a peninsula S.S.E. of the southern end of America, reaching in Trinity Land almost to 62 degrees south latitude. Outwardly these lands exhibit a naked, rocky, partly volcanic desert, with high rocks, destitute of vegetation, always covered with ice and snow, and so surrounded with ice that it is difficult or impossible to examine the coast very closely."

A singular, and indeed fallacious, argument has been advanced by Captain Maury in favour of the theory that the Antarctic regions are occupied by a great continent. "It seems to be a physical necessity," he argues, "that land should not be antipodal to land. Except a small portion of South America and Asia, land is always opposite to water. Mr. Gardner has called attention to the fact that only one twenty-seventh part of the land is antipodal to land. The belief is, that on the polar side of 70 degrees north we have mostly water, not land. This law of distribution, so far as it applies, is in favour of land in the opposite zone." Surely a weaker argument has seldom been advanced on any subject of scientific speculation. Here is the syllogism: we have reason to believe (though we are by no means sure) that the Arctic regions are occupied by water; land is very seldom found to be antipodal to land; therefore, probably, the Antarctic regions are occupied by land. But it is manifest that, apart from the weakness of the first premiss, the second has no bearing whatever on the subject at issue, *if the first be admitted*: for we have no observed fact tending to show that water is very seldom antipodal to water, which would be the sole law to guide us in forming an opinion as to the regions antipodal to the supposed Arctic water. On the contrary, we know that water is very commonly antipodal to water. We have only to combine what is known respecting the relative proportions of land and water on our globe with Mr. Gardner's statement that twenty-six out of twenty-seven parts of the land are antipodal to water, to see that this must be so. There are about 51 millions of square miles of land and about 146 millions of square miles of ocean. Now about 49 millions of square miles of land are antipodal to water, accounting therefore for only 49 millions out of the 146 millions of square miles of ocean surface; the remaining 97 millions of square miles of ocean are, therefore, not antipodal to land, but one half (any we please) antipodal to the other half. In fact, we have this rather singular result, that the ocean surface of the globe can be divided into three nearly equal parts, of which one is antipodal to land, while the other two parts are antipodal to each other. This obviously does not force upon us the conclusion that an unknown region must be land because a known region opposite to it is oceanic; and still less can such a conclusion be insisted upon when the region opposite the unknown one is itself unknown.*

* Whether the relation above-mentioned respecting land regions is noteworthy may very well be questioned. It will be seen that Captain Maury regards it as seemingly a physical *law* "that land should not be antipodal to land." Now this is by no means satisfactorily indicated. As a question of probability it is not certain that the present relation, by which twenty-six parts out of twenty-seven of the land are antipodal to water, can be regarded as antecedently an unlikely one, when nearly three-fourths of the whole surface are occupied by water, and when, also, the bulk of the land and water regions consist of such great surfaces as those we call continents and oceans. Granted these preliminary conditions, it would appear, indeed, that only by a very remarkable and, as it were, artificial arrangement of land and water could any but a small proportion of the land be antipodal to land. The stress laid by Maury on the observed relation seems to me, indeed, as unwarranted as that laid by Humboldt on the fact that the great southerly projections of the land lie nearly in the same longitude as the great northerly projections.

So far, indeed, as the geographical evidence extends, it seems probable that there exists within the Antarctic circle an elevated region bearing somewhat the same relation to the great promontories terminated by Cape Horn and the Cape of Good Hope, as well as to the relatively elevated region indicated by the islands to the south and south-east of Australia, which the Hindoo Koosh bears to the great mountain-ranges of Asia. We seem to have in the Antarctic high lands the great central elevation whence three great lines of elevation extend. That the great mountain range which forms the backbone of South America is continued under water, rising again in the south Shetland Isles and Graham's Land, would, indeed, seem altogether probable; and it may be remarked as a coincidence of some importance that the mountains seen by Ross on the other side of the Antarctic Circle—Mounts Sabine, Crozier, Erebus, and Ross—lie in a chain tending in the same direction. But although we might thus be led to regard the Antarctic regions as forming a great central region of elevation, it by no means follows that this region is of the nature of a table land.

Meteorological considerations have been urged by Maury for the theory of Antarctic lands in large masses, "relieved by high mountains and lofty peaks." He considers that it is to such mountains (performing the part of condensers) that the steady flow of "brave" winds towards the South Pole is to be ascribed. "Mountain masses," he says, "appear to perform in the chambers of the upper air the office which the jet of cold water discharges for the exhausted steam in the condenser of an engine. The presence of land, therefore, not water, about this south polar stopping-place is suggested." And he attaches considerable weight, in this connection, to the circumstance that the barometric pressure is singularly low over the whole Antarctic Ocean,*—as though there were here the vortex of a mighty but steady whirlwind. "We may contemplate the whole system of 'brave west winds,' circulating in the Antarctic regions, in the light of an everlasting cyclone on a gigantic scale—the Antarctic continent in its vortex—about which the wind in the great atmospherical ocean all round the world, from the pole to the edge of the calm belt of Capricorn, is revolving in spiral curves, continually going with the hands of a watch, and twisting from right to left." However, it would be unsafe to base the theory of an Antarctic continent on speculations such as these. And still less can we assume with Maury that Antarctic volcanoes play an important part in the economy of southern meteorological phenomena. There is no reason for supposing that active volcanoes have any special action in determining atmospheric relations. Capt. Maury suggests that we may, "without transcending the limits of legitimate speculation, invest the unexplored Antarctic land with numerous and active volcanoes," and this certainly may be granted, for two volcanoes (one in action) have been seen there. But it would be unsafe to infer that such volcanoes are "sources of dynamical force sufficient to give that freshness and vigour to the atmospherical circulations which observations have abundantly shown to be peculiar to the southern hemisphere." Volcanoes would need to be so numerous and so active, in order to produce the imagined effect, that the whole southern continent would be aglow like a gigantic furnace. A hundred Etnas would not produce the thousandth part of the in-draught which Maury ascribes to Antarctic volcanoes. Assuredly, we may say with Maury, but more significantly, that "volcanoes are not a meteorological necessity." "We cannot say that they are," he proceeds, "yet the force and regularity of the winds remind us that their presence there would not be inconsistent with known laws." He believes, in fact, that the steady winds may be partly formed as an in-draught feeding volcanic fires. It is as well to remember, when ideas so wild are mooted, that, as Maury himself remarks, "we know, ocularly, but little more of the topographical features of Antarctic regions than we do of those of one of the planets." "If they be continental," as he proceeds, "we may indeed, without any unwarrantable stretch of the imagination, relieve the face of nature there with snow-clad mountains, and diversify the landscape with flaming volcanoes;" but we must not forget that this *is* a work of imagination, not a theory which can be insisted upon as though it represented a geographical fact.

While on this subject, however, I cannot refrain from quoting a very striking passage from a letter by Capt. Howes, of the *Southern Cross*, because, although it relates in reality to the phenomena of an Aurora Australis, it presents a scene such as we might conceive to accord with the conception of an Antarctic region covered with volcanoes whose combined action made the whole continent at times as one vast furnace. Apart from fancies such as these, the description is full of interest:—"At about half-past one," he says, "on the second of last September, the rare phenomenon of the Aurora Australis manifested itself in a most magnificent manner. Our ship was off Cape Horn, in a violent gale, plunging furiously into a heavy sea, flooding her decks, and sometimes burying her whole bows beneath the waves. The heavens were as black as death; not a star was to be seen when the brilliant spectacle first appeared. I cannot describe the awful grandeur of the scene; the heavens gradually changed from murky blackness till they became like livid fire, reflecting a lurid, glowing brilliancy over everything. The ocean appeared like a sea of vermilion lashed into fury by the storm; the waves, dashing furiously over our side, ever and anon rushed to leeward in crimson torrents. Our whole ship—sails, spars, and all—seemed to partake of the same ruddy hues. They were as if lighted up by some terrible conflagration. Taking all together, the howling, shrieking storm, the noble ship plunging fearlessly beneath the crimson-crested waves, the furious squalls of hail, snow, and sleet driving over the vessel and falling to leeward in ruddy showers, the mysterious balls of electric fire resting on our mast-heads, yard-arms, &c., and above all the awful sublimity of the heavens, through which coruscations of auroral light would often shoot in spiral streaks and with meteoric brilliancy, altogether presented a scene of grandeur and sublimity surpassing the wildest dreams of fancy."

(*To be continued*).

* This curious circumstance cannot be explained, as Maury supposes, by the existence of upflowing currents of air, however occasioned. The total pressure of the air over any region is not affected by motions taking place within the air, any more than the total pressure of water upon the bottom of a tank is affected by motions taking place in the water. There are reasons for believing that the true explanation of the low Antarctic barometer lies in the fact that the ocean surface is in Antarctic regions *above*, and in Arctic regions *below*, the mean level. The excess of ocean surface in the southern hemisphere indicates an overflow, as it were, of water southwards, which must lead to such a relation.—See my 'Light Science for Leisure Hours," Second Series.

ERRATUM.—In the paragraph at the bottom of second column, page 9 (last week's KNOWLEDGE) for "equatorial circle" read "equatorial coudée."

THE Western Union Telegraph Company at a meeting last month, declared the usual 1¾ per cent. quarterly dividend. The present quarter closes the fiscal year, which exhibits gross earnings of nearly 26,000,000 dols., about 500,000 dols. more than last year, but, on account of expenses during the strike, the net earnings will not be quite so large. The last and present quarters show an excess of net earnings over the corresponding quarters of last year.

OPTICAL RECREATIONS.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

(*Continued from p. 482.*)

WE stated on p. 307 that light travels in straight lines, but we must now introduce a qualification into this general statement, and add, *as long as it is passing through a homogeneous medium—or one of absolutely uniform density throughout.* This is the way we proceed in physical science. We first enunciate a law which we assume to be universal, and then we deal with what are—or seem to be—exceptions to it; and ascertain and show whether they are really so, or whether both they and the facts on which our original assumption was founded may not in reality be susceptible of inclusion in a higher and more general law still. Now while it is perfectly true, as we have just said, that the propagation of light is absolutely rectilinear (or in straight lines) in a medium of uniform density, when it passes from a rarer medium into a denser one, or *vice-versâ*—save in a direction accurately square to the surface bounding such two media—it is bent from its original direction, or, to use the technical term, "refracted." This may be well shown, and an approximation made to the determination of the law of refraction, by the simple apparatus depicted in Fig. 14.

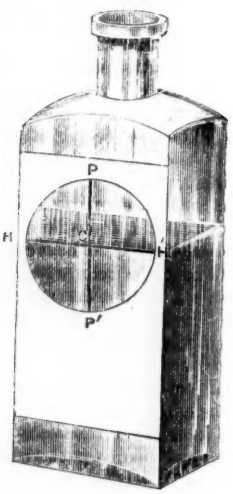

Fig. 14.

It is nothing more than a clear glass (18-oz) physic bottle, on the front of which a piece of white paper is pasted. Prior to sticking the paper on, an accurate circle must be cut out of it; and, when all is dry, two thick diametrical lines, P, P′ H H′, may be ruled in ink on the glass, the first vertical and the second truly square to it, of course horizontal. Or, if preferred, two pieces of stout silk cord may be gummed across the aperture. A piece of blackened card should be cut out to cover one of the narrower sides of the bottle, and near the top of this a hole; or, perhaps, preferably a horizontal slit should be cut. The slit must be a very narrow one. We must now fill our bottle exactly up to the line H, H′ with water, *just* coloured with a little milk, and, immediately before beginning our experiment, puff a mouthful of cigar smoke into the mouth of the bottle. We employ the milk and the smoke in order that we may see our beam of light, for the student will recollect (p. 306) that light passing in a direction across our line of sight is absolutely invisible. Very well, then, we have next to obtain our beam of light; and, undoubtedly, for the majority of optical experiments, direct sunlight is the best. In the present case, though, this involves the use of a darkened room with a narrow beam of sunlight admitted through a hole in the shutter. If the reader has any apartment at his disposal which he can so employ, and which is sufficiently light-tight, so much the better; if not, he may use a good kerosine lamp and a bull's-eye condenser, and conduct his investigation at night. Whichever source of light he employs, he must, by the aid of a looking-glass or otherwise, throw the beam proceeding from it through the slit in the blackened card at the side of the bottle, shifting the mirror about until the line of light strikes the surface of the water at C. Our puff of tobacco smoke will enable him to do this. Now trace the course of the light through the slightly turbid water, and carefully note the path it takes. Is no longer preserves its original direction, but is bent *towards* PP′; in other words, its track becomes more upright. Bear in mind that, coming through the side of the bottle, it has originally struck the surface of the water obliquely. Had we sent it through the mouth of the bottle truly square to the surface of the water it would have preserved its perpendicular direction throughout—much in the same way (though, of course, in one sense, for a different reason) that a perpendicular ray which falls on a mirror is reflected accurately back along the line by which it originally travelled. This by the way. To return to our experiment. Note where the beam of light cuts the semicircle H, P, H′, before entering the water; as also the point where it crosses the semicircle H, P′, H′, after having done so, and draw ink lines from these points to the perpendicular P, P′, taking care that those lines are parallel to H, H′. If we measure these lines carefully with a pair of compasses we shall find that the one above the water is—as nearly as may be—$1\frac{1}{3}$ times the length of the lower one. And, what is particularly to be remarked, that while the length of these respective lines varies with the obliquity with which the light falls on the surface of the water, the *proportion* between them remains invariable. Before proceeding to investigate the law of Refraction we may just remark incidentally that, as our experiment has been so far conducted, evidently part of the light has been reflected from the surface of the water, the unreflected portion alone, of course, penetrating it. For our present purpose, however, we may neglect this reflected part altogether, and consider that the whole incident beam enters the water, and is bent at the surface where it does so. By the aid of Fig. 15 we may now explain the law in virtue of which

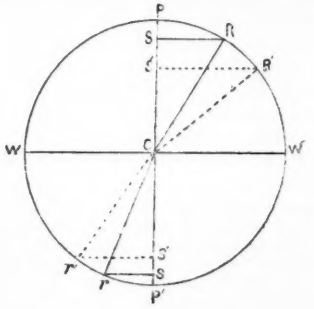

Fig. 15.

light follows a fixed and definite course in passing from any medium into another of different density—a law discovered by Snell during the first quarter of the seventeenth

century. We have said above that had we sent our beam of light perpendicularly into the water it would have pursued a rigidly rectilinear path throughout. If, though, light struck its surface at all obliquely, refraction would occur at once. As we have had ocular demonstration by the aid of our bottle, when light passes from a rarer medium into a denser one it is bent towards a perpendicular to the refracting surface. On the other hand, when it passes from a denser medium into a rarer one it is bent from the perpendicular. And this brings us to the incidental mention of the principle of reversibility. By whatever path light travels from air into water, by that same path will it return from water into air. So, again, in Figs. 6, 10, 11, the object and its reflected image may be regarded as interchangeable in their respective positions. We shall probably have occasion to reiterate and insist upon this law, lying as it does at the root of numerous optical phenomena. Reverting, however, to our figure. The law discovered by Snell was this—that when light passes from any medium to another of different density the sine of the angle of incidence always bears a fixed and definite ratio (or proportion) to the sine of the angle of refraction. The sine of an angle is defined in old mathematical books—in a way much more intelligible to the learner than that employed in more modern ones—as a line drawn from one extremity of an arc at right angles to the diameter from the other extremity. Thus, in Fig. 15, R S is the sine of the angle R C P; R′ S′ the sine of the angle R′ C P; *r s* the sine of the angle *r* C P′, and *r′ s′* the sine of the angle *r′* C P′. A little attention will show how these conform to the definition just given. Then, Snell's law says this: if (as we shall find to be the case) R S is $1\frac{1}{3}$ times the length of *r s*, R′ S′ will be $1\frac{1}{3}$ times the length of *r′ s′*, and so on for any angle of incidence we may select. Now, here we will pause to call attention to a very remarkable circumstance. We have said that light passing from air into water will be refracted, if it do so, "at any angle of incidence;" but, if the student has followed us attentively so far, he will see that the converse of this will not hold good, and that our choice of angles of incidence in the passage of light from *water to air* is not unlimited. For it is easy to see that the angle of incidence might be so great that the sine of the angle of refraction being $1\frac{1}{3}$ times as large must be greater than CW, the radius of the circle, which is impossible; or, to put it another way, he may select such an angle of incidence in water that the light must emerge parallel with the surface, and when we increase such angle the light *cannot get out of the water at all*, and is totally reflected. The incidental angle at which the emergent ray is parallel to—or, rather, *in*—the surface of the water, is known technically as "the critical angle." Total reflection may be observed by looking obliquely upwards at the inner surface of the water in a clear glass tumbler at the image of a candle, a silver spoon, or other bright object held on the other side of the tumbler. It may also often be noticed in aquaria, such as the one at Brighton, in which the surface of the water seen at the proper angle from beneath reflects the fish near it, and shines like molten silver. Or, by turning our card, which covers the side of the bottle in Fig. 14, upside down, so that the slit in it is below the level of the water, we may reflect our beam of light upwards to its inner surface, and trace its reflection visibly. The "mirage" of the desert is believed to have its origin in total reflection from the surface formed by two adjacent strata of air of different temperatures and densities. We have spoken of the sine of the angle of incidence of a ray of light passing from air into water being $1\frac{1}{3}$ times the length of the sine of refraction. It is more accurately 1·336 times that length; and this number 1·336 is called "the index of refraction" of water. The denser a body the higher its index of refraction. Thus it is 1·575 in flint glass, and sometimes as high as 2·75 in the diamond. Hence the incomparable lustre of this stone. Numerous illustrations of refraction will occur to the reader. One of the most familiar is none the less instructive. Let him get a pie-dish, and put a sixpence at the bottom of it. Now, let him walk backwards until the side of the dish just hides the sixpence, and remain perfectly still while some one else pours water into the dish. The effect will be to bring the sixpence into view again. Fig. 15 will show how the water bends the rays of light from the coin over the rim of the dish. Or he may vary the experiment by so placing a lamp that the side of the pie-dish casts a long shadow on the bottom of it when empty. Then, as before, on pouring in water, the shadow will be seen to shorten perceptibly, and to approach the side casting it. So an oar or a stick partly immersed in water seems broken or bent at the surface; and a fisherman looking obliquely at the bottom of a clear lake from its bank sees it apparently only about three-quarters of its real depth. Or, instead of water, we may employ a thick piece of plate-glass to produce refraction; and, hiding some writing behind the edge of a thin book lying flat on a table, as we did the sixpence with the edge of the pie-dish, bring it into view again by placing our piece of plate-glass upon it. And the mention of plate-glass suggests to us here to investigate the course of a ray of light passing through such a medium. In Fig. 16, G G is a section

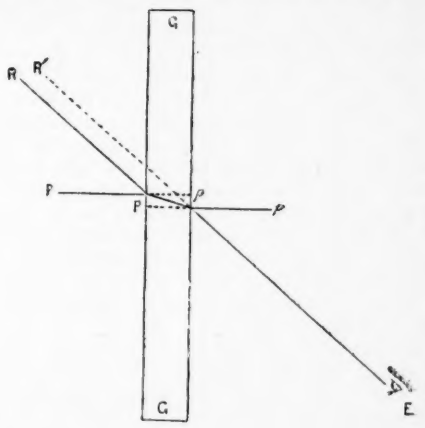

Fig. 16.

or edgeways view of a window-pane; R P, a ray (suppose from a tree-top) incident on the outside of the glass at P. Then, as we have seen above, this ray will be bent *towards* the perpendicular in the glass. On reaching the other surface, however, at *p*, it will be bent *from* the perpendicular, and will follow the direction *p*E, parallel to RP, and will be seen by an eye at E as though it emanated from R′, thus slightly raising our imaginary tree-top. Inasmuch, however, as the whole landscape is equally raised, *for the same obliquity of vision*, no sensible distortion is apparent. Quite obviously, objects from which rays fall square on to the surface of the glass suffer no apparent change of position whatever. It must be pretty evident that the higher the refractive index of any substance, the greater the displacement of a ray of light passing through it; so that if we could conceive a window formed of sheets of diamond, and one pane to be left open, the landscape would be very notably raised as viewed through

a closed pane contiguous to the open one. A most beautiful experiment, illustrating both refraction and total reflection (for the idea of which we are indebted to a little book on "Light," by Mayer and Barnard, published by Macmillan & Co.), will probably come in here most appropriately. Fig. 17 is intended to illustrate it.

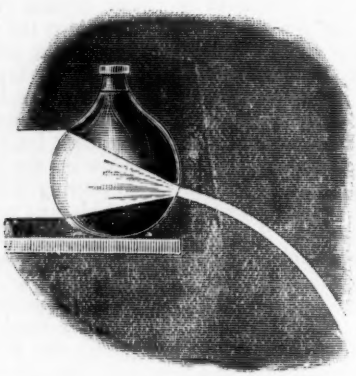

Fig. 17.

The reader should buy the biggest globular glass flask that he can obtain, and have a hole drilled in its side at the shop where he buys it. Stopping this hole with a cork, the bottle must be filled with water, and a parallel beam of light from a kerosine lamp and a bull's-eye lens be projected on to the side of the flask, in the way illustrated by our figure. It must be so managed that the refraction shall bring the rays of light, of which the beam is composed, to a focus on the cork, and the lamp should be enclosed in a box, or otherwise so surrounded by opaque material, that the room would be dark but for the light passing into the bottle. This condition of things being secured, a pail may be placed on the floor, and the cork taken out of the side of the bottle; when a most beautiful effect will be perceived. The light will be totally reflected from the *inner* surface of the issuing jet of water, which will appear like a stream of molten silver, and the interposition of coloured glasses between the source of light and the bottle will tinge this of their own hues. Of course, sunlight or the electrical light will give even more brilliant results still. It was by the aid of the latter, projected in this way through variously-coloured media, that the so-called "Fairy Fountain" was managed which was exhibited at the defunct Panopticon in London.

In our next paper we shall enter upon the subject of refraction through successive surfaces, which, unlike those of the window-pane spoken of above, are inclined to each other.

THE conversazione of the Society of Telegraph Engineers and Electricians was held at King's College last Thursday evening. Several highly interesting pieces of apparatus were exhibited, including an artificial cable, representing, in resistance and inductive capacity, about 8,000 miles of submarine line, viz., about 16,000 ohms and 2,450 microfarads, by Latimer Clark, Muirhead, & Co. (Limited); Professor Dr. Dvorak's acoustic experiments, showing the conversion of sonorous vibrations into a continuous current of air; and the model Paris legal ohm (sent by Professor Mascart), by W. H. Preece, F.R.S. In the Physical Lecture Theatre, Mr. H. Tomlinson exhibited and explained experiments on the effects of mechanical stress on the electrical resistance of nickel, which showed that up to a certain point the stress reduces the electrical resistance of nickel, notwithstanding the fact that the wire is increased in length and proportionately decreased in sectional area.

THE INTERNATIONAL HEALTH EXHIBITION.

VII.—WATER AND WATER-SUPPLIES.

(*Continued from p. 9.*)

RECENT researches in the natural sciences have one characteristic of value in common, they commence with the simplest condition of the individual, and trace it step by step through the progressive stages of its development and degeneration. A somewhat analogous process to that of the evolutionist might be applied here in the record of the cycle of events which constitute what we may term the life-history of a drop of water.

The principle of the conservation of matter teaches us that do what we will we cannot create, nor can we destroy, a single atom. The water at present in our terrestrial globe equals in quantity the water of the mystic age when all was void or nebular; but the changes to which it has been subjected through countless periods remind us that although matter is immutable, that other great entity called energy can, through its transformations, remodel it, as it were, until its original forms become obscured.

In our universe we always start with something tangible; in this case let us commence with a drop of water, and try to interpret some of the varied phenomena which are to be attributed to its agency. In this way shall we learn what a powerful sway it exercises over the destinies of our earth, how it helps to endow it with that which distinguishes it as a *living* in contradistinction to a *dead* world, and how we are enabled to find therein a striking exemplification of the laws of matter and of energy which we have just cited.

The heat of the sun acting upon the waters of the earth, whether they are in the form of oceans, rivers, snow-fields, or glaciers, causes the original solid or liquid to give place to the gaseous condition. The invisible vapour thus produced rises in the atmosphere according to the law of diffusion of gases, and remains thus until the air containing it cools below its point of saturation, or dew-point. A change then takes place, which is usually brought about in two principal ways; either by contact of a colder current of air with the moisture-laden stream, or by the rise of the latter into the colder upper stratum of the atmosphere. The condensation takes place through deposition on free surfaces, either by contact with the cold earth or mountain sides, or if at a great elevation, with excessively minute particles which pervade the air,* thereby giving rise to the formation of mists and clouds. In any case vapour is formed, and remains suspended in the atmosphere in tiny particles of liquid, or if the temperature be low enough, as aggregates of icy dust. A continuation of the process adds to the size of the cloud particles, until they can no longer be suspended, and hence descend upon the earth, in virtue of gravitation, as rain, sleet, hail, or snow. The theory of condensation around nuclei of cosmic or other origin, divests rain, even in the uppermost regions, of its character of absolute purity, and by the time it reaches the earth, it no longer bears the slightest semblance to chemically pure water, but is highly charged with matters, both solid and gaseous, which are destined to create profound changes during its action as a geological agent. We will not here consider the progressive stages undergone by water which comes to the earth in a solid form to feed the snow-clad regions of its lofty mountain ranges, as, after all, it resolves itself ultimately

* Coulier and Mascart, "Naturforscher," 1875, p. 400; Aitken, Proc. Roy. Soc. Edin., December, 1880.

into liquid water, and thenceforward behaves precisely as in the case of ordinary rain-water.

In virtue of its absorbing properties, our drop of rain-water, on reaching the surface of the earth through its envelope of air and dust, has partaken of certain gases, such as carbonic acid, oxygen, and a small proportion of nitrogen. Carbonic acid gas preponderates, as it is more easily soluble in water than the other gases; it contains between thirty to forty times more of that gas than the atmosphere. Of solid impurities in England, it is estimated that there are about 3·95 in 100000 parts.* In certain districts other gases and substances are superadded, such as sulphurous acid, and sulphuretted hydrogen in the districts of active volcanoes, and sulphuric and nitric acids in the vicinity of manufacturing towns. It is needless to observe that water thus charged would tend very largely to modify the surface of the earth generally, and buildings, &c., more markedly, by a conversion, *e.g.*, of the lime of mortars, marble monuments, &c., into sulphate of lime through the action of the sulphuric acid. Examples of such action have been carefully recorded by Angus Smith,† and more recently by Geikie.‡ Sulphates of alkalies and alkaline earths, and chlorides, especially common salt in the neighbourhood of coasts, swell the list of impurities which crowd into a drop of water before it commences its work upon the crust of the earth. Other inorganic particles which have been detected vary in character with the surrounding circumstances; amongst them may be mentioned specks of fine terrestrial dust, and dust of cosmic origin, containing minute spherules of iron.‖ Some of the organic impurities of rain-water which have been derived from the air were discoursed upon at length in our last communication.

Thus fortified, rain-water is peculiarly adapted to commence its work of modification upon the crust of the earth. Its carbonic acid is augmented in quantity, and it thus becomes a powerful solvent, particularly upon substances composed of or containing lime salts. Now, since vast tracts of country are formed of limestones, marbles, chalks, and other calcareous rocks, its action must indeed be enormous. Large quantities of lime are dissolved and carried away by the water which percolates through the earth to its underground reservoirs. In some instances these calcareous waters drop through caverns, and so highly are they charged with lime that evaporation of the water, as it leaves the roof of the cave and reaches the floor, is sufficient to deposit the lime in concentric rings, which afterwards take on a radiated structure, and give rise to more or less complete pillars, some dependent, and some in the form of upright bosses on the floor,—stalactites and stalagmites. Deposition through evaporation also goes on in rock fissures and cavities; veins and druses full of crystals, sometimes of rare minerals in exquisitely developed and perfect forms, are thus evolved. A quantity of the water is often held in these crystals as water of crystallisation, and subsequent action, such as that of heat or pressure, may entirely change the character of these deposits; instances may be found in the mineral calcite and its allied forms.

The influence of the carbonic acid of rain-water upon rock structure is sometimes most complicated, and a vast field of inquiry lies open before the experimental petrologist in this direction. As an example, we may point to the large group of metamorphic rocks of which the serpentines are the most noteworthy; here§ the carbonated waters appear to remove the oxidised iron and magnesia of the mineral olivine (in serpentines derived from olivine-rocks), as precursory to its conversion into the beautiful green material which is so much admired in architectural decorations and ornaments. Even the silicates, as of lime, soda, and potash, crumble away in time before its action; and thus are the felspars of granite and diorite broken down into sands and clays; their alkalies are removed as soluble carbonates, and the silica is generally liberated in the form of a hydrated bisilicate of alumina called *kaolin*, a substance not unknown to Messrs. Doulton & Co., of Lambeth, whose exhibits we recently reviewed.

The oxygen taken up by rain-water is also added to during its percolation through the soil. Its action upon calcareous rock-masses is not of very great importance, unless they happen to contain a large proportion of iron; but in regions where the rocks are chiefly of igneous origin, as in Devon, Cornwall, the lake district, Cymric mountains, and Scottish Highlands, minerals such as hornblende, augite, olivine, apatite, &c., occur largely, and the oxygen plays an important part in the conversion of certain of the mineral components into ferrous and manganous oxides. The rocks thus weather or crumble away to form soils through which future waters penetrate, and from which they take their character. The formation of soil from volcanic rocks which are rich in apatite or phosphate of lime, through this chemical disintegrative action of water, is of the first importance to the agricultural economist.

Our remarks upon the organic impurities in water were confined to such of them as are chiefly derived from the air in the germ condition. On reaching the earth, however, rain-water becomes the vehicle for enormous quantities of other organic matters which exercise profound chemical changes; they act upon minerals to a degree which would scarcely be credible at first sight. The so-called humus or ulmic acids, which they create, combine with mineral bases to form soluble substances which are afterwards changed into carbonates. A detailed account of these reactions may be gleaned from the researches of Senft* and Julien.†

What is more apparent, however, is the reducing action of water through the agency of contained organic matter. Any one who has visited districts abounding in red sandstones, as along the northern and eastern coasts of Scotland, would be struck by the numerous whitish and greenish-white spots and streaks which mottle the rock every here and there. The cause of these discolorations has been explained thus:—The organic matter in the water abstracts oxygen from the ferric oxide, which imparts the red colour to the stone, and reduces it to the condition of a ferrous oxide, which is thereafter removed by becoming a soluble carbonate or an organic salt. Organic matter also acts as a deoxidiser by the conversion of sulphates into sulphides, and is thus capable, for instance, of completely metamorphosing districts composed of sulphate of lime, &c. Whilst speaking of gypsum, or sulphate of lime, we are reminded that a certain proportion dissolved in water gives the latter undesirable characters which are often difficult to eradicate; we shall have occasion to discuss this subject when we come to treat of the practical details of water supplies. Gypsum contains a large quantity of water in its composition; when deprived of this water it is called anhydrite, and in becoming thus changed it loses in bulk; this is a feature of considerable interest to the dynamical geologist, who finds in it an explanation for unaccountable upheavals in districts where

* Sixth Report of the Rivers Pollution Commission, p. 29.
† "Air and Rain," 1872, p. 444.
‡ "Proc. Roy. Soc. Edin., 1879-80," p. 518.
‖ Jung, "Bull. Soc. Vaudoise Sci. Nat.," xiv., p. 493; Von Lasaulx in "Tschermak's Mineral. Mittheil.," 1880, p. 517.
§ Dana, "System of Mineralogy," 5th Ed., p. 258.

* "Zeits. Deut. Geol. Ges.," xxiii., p. 665; xxvi., p. 945.
† "On the Geological Action of the Humus Acids." Proc. Amer. Assoc., xxviii., 1879, p. 311.

anhydrite obtains to any large extent; its conversion by hydration into gypsum being accompanied by a sensible increase in bulk.

Of the mechanical action of rain-water upon the earth, we cannot do more than allude briefly to its power as a denuding and disintegrating agent. The formation of rivers and lakes—and, indeed, the whole landscape scenery of the world—is largely determined by the action of water. The rain that does not sink into the ground flows off in channels which it grooves for itself down the sides of hills to rivers, lakes, and the sea. In its passage over the rocks the water of rivers acts both mechanically and chemically; it holds in suspension not only insoluble particles, but dissolved matters, which vary with the character of the soil it has traversed; it is augmented by springs which may bring to it water which has accumulated from a distant and distinct region; it is crowded with diverse forms of plant and animal life, and may be polluted by the sewage and other offensive products, not only of densely-populated districts, but even of isolated tenements. This is well shown in the subjoined figure (Fig. 14), for the use of which we are indebted to the courtesy of Mr. P. A. Maignen, of Great Tower-street, E.C.

Fig. 14.—Excellent mountain stream, affording a supply to a country-house, and at a lower point to a small village. Defective drains and overflow from cesspools (shown by dotted lines) polluting the stream.

In continuation of our remarks, we shall trace the history of a drop of water from other sources, with special reference to the waters of the Thames and the London water-supply. We trust that these notes will enable our readers to form an adequate estimation of the value of the practical appliances which we shall soon place before them, as in pointing out the details of mechanism it will be found necessary to refer constantly to what we have here attempted to explain.

Curious Case of Cause and Effect.—During a storm at Greenville, R.I., May 9, the lightning ran by the telephone wire to the Windsor Mill, where there is no telephone, but the wire is disconnected just outside the building. The lightning was led by the wire to the corner of the mule and weaving rooms, and entered the building under the jet. It followed the water-pipe and set the sprinklers going, and at the same time fired the stock in the mules. By this singular provision of an active extinguishing agent at the moment the fire started, serious loss was prevented, as the fire was soon drowned out. Many of the spindles in the mules lost their temper, and some of the belts were burned, but the mill was saved. —*Scientific American.*

Reviews.

SOME BOOKS ON OUR TABLE.

Freemasonry Traced from Prehistoric Times, &c. By A Master Mason. (London. 1884.)—We are just in this tremendous difficulty with the tract whose title heads this notice: its author is inspired! At least he says he is—and he ought to know. He traces Masonry from the Magi, and suggests the establishment of a Supreme Grand Lodge and a Supreme Grand Chaplain of the whole world. He further is good enough to inform us on the cover that "All known substances are not only held together by electricity, but all things, atoms included, are composed entirely of electricity." This is Jachin and Boaz, Hiram and Tubal Cain run mad with a vengeance.

On an Error in Elliptic Motion. By A Student. (Leeds: John Lennox. 1884.)—The "Student" regards the Dynamics of Tait and Steele as radically unsound, has mounted a piece of apparatus to illustrate elliptic motion, and gives a sketch of a "Typical orbit. Diagram obtained by placing magnet beneath plane and oiling sphere," among other illustrations. None are so blind as those who *won't* see.

The Unlimited Debt. By F. W. D. Mitchell. (Dublin: A. Thom & Co., 1884.)—Mr. Mitchell is a disciple of Mr. George's, and apparently—with Proudhon—regards property (in the form of land) as theft. He essays—not very successfully—to answer the Duke of Argyll's article, "The Prophet of San Francisco," in the April number of the *Nineteenth Century.* One elementary fact is certain—either land must remain in private hands, or it must become the property of the State. In the latter case rent and taxation must become synonymous; and then God help the cultivator of the soil!

The Abuse of Blue Ribbonism. By a Moderate Drinker. (London: Iliffe & Son.)—This is a temperate protest against the rant but too often heard upon teetotal platforms. Starting with the axiom that drunkenness is both a curse and a sin, the author shows, alike from Scriptural teaching and from the every-day experience of mankind, that the use of a strictly moderate amount of fermented liquor is at once pleasant, harmless, and conducive to health.

The Slide-rule Extended. By Major-General Hannyngton. (London: E. & F. N. Spon. 1884.)—By an extension of the slide-rule, General Hannyngton has produced an instrument which cannot fail to be of value to all engaged in much logarithmic computation of the kind involved in reducing astronomical observations, making intricate divisions in a clearing-house, finding the cubic contents of timber, and the like. His pamphlet explains the principle of such extension, and illustrates the use of the improved rule by examples.

A Short Exposition of Massage, &c. By G. Fenton Cameron. (London: Baillière, Tindall, & Cox.)—Massage appears from this tract to be a kind of medical shampooing, or rather kneading; and the tract itself may be looked upon as a message to such as may need it.

Hints on Sanitary Laws, &c. By G. F. Chambers, F.R.A.S. (London: Allman & Son. 1884.)—This short digest of the numerous Acts of Parliament regulating the sanitary condition of London is issued by the National Health Society, and will be found useful by all interested in the health of the metropolis. It gives a clear exposition of the law, and teaches the householder at once with what sanitary requirements he must himself comply, and how to enforce obedience to them on the part of his neigh-

bours. It is followed (in an Appendix) by a Directory of the Sanitary Officers, &c., District Asylums, and Hospitals for Infectious Diseases in the metropolitan area. It is noted by Mr. Chambers in his Preface that the Public Health Act of 1875, under which every other rural and urban sanitary authority in the kingdom is governed, excluded London! a curious illustration of the result of that plethora of empty verbiage and absence of real work which characterises the House of Commons.

Moffat's Class Register—Moffat's Half-time Register—Amner's Inspector's Test Cards—Matthew's unexcelled Series of Arithmetical Test Cards. (London: Moffat & Page.)—These publications are adapted to the latest requirements of the Education Department, and, as is generally the case with works issued by Messrs. Moffat & Co., are unexcelled for use in Public Elementary Schools. The test cards are designed to supply the examiner with a series of questions (and replies to them) calculated to show the progress of the pupils in the various standards.

Sewing made Easy, with Notes of Lessons on various Stitches. (London: Moffatt & Page, 1884.)—We have purposely excluded this most practical work from the previous heterogeneous heading, inasmuch as its use is by no means confined to the schools for which it was apparently primarily intended. We have submitted it to a lady skilled in needlework, for her unbiassed opinion, which we append. "This," she says, "is an excellent little book, on a most simple system; by the aid of which sewing of all sorts may be easily taught. No mistress should be without it. There is a good list of cheap paper patterns, sold by the publishers, at the end of it, illustrations of garments of various sorts, and explicit directions for every kind of darning and marking. You may very safely recommend it." Which, on the strength of such testimony, we hereby do.

The Book of Health. Part I. Edited by MALCOLM MORRIS. (London: Cassell & Co.)—This first part of what promises to be a succinct Encyclopædia of Hygiene contains an introductory chapter by Mr. W. S. Savory, F.R.S., extending over 100 pages, and the commencement of an essay by Sir Risdon Bennett, M.D., F.R.S., "On Food and its Uses in Health." It gives promise of being at once a useful and a readable work.

The Countries of the World. Part I. By ROBERT BROWN, M.A., F.R.G.S., Ph.D. (London: Cassell & Co.) With its really admirable illustrations, and its chatty and readable letterpress, Dr. Brown's pleasant introduction to geography and ethnology can hardly fail to command an extensive circle of readers. An excellent map of the world, on Mercator's projection, accompanies this first part.

Cassell's Popular Gardening. Part I. Edited by D. T. Fish. (London: Cassell & Co.)—This profusely-illustrated book supplies just the kind and amount of information required by every possessor of a garden, whether in lordly proportions it may surround a country mansion, or take the form of the two narrow strips of "back and front garden" of a suburban villa. Garden-pots and potting, ground operations, florists' flowers, ferns, kitchen-gardening, and greenhouse plants are only some of the subjects treated of in the number before us.

Cassell's Household Guide. Part I. (London: Cassell & Co.)—Here is the first instalment of another encyclopædia—this time, however, devoted to domestic economy. Domestic finance, house furnishing, cookery, domestic surgery, household carpentry, dogs, gymnastics, chicken-keeping, and decorative art, we may select at random from the contents of this number to show its scope and character.

European Butterflies and Moths. Part I. By W. F. KIRBY. With coloured plates. (London: Cassell & Co.)—This book, with its superb illustrations, will doubtless soon be upon the shelves of every lepidopterist in the three kingdoms. Supplying, as it does, the means of identification of every leading form of European butterfly and moth, it may well be commended to the traveller and the sojourner in the country. Like the four previously mentioned works, this is published at a price which suggests the idea that it must almost entail a loss upon every one concerned—save always the fortunate purchaser.

Amateur Mechanics. No. 18, Vol. 2. (London: Iliffe & Son.)—A handy and useful monthly publication for the amateur turner, joiner, fitter, and engineer.

The Sanitary Engineer. British and Continental Edition. (New York.)—A weekly paper containing much that is interesting to all concerned with the question of health, on both sides of the Atlantic.

Illustrated Sports is a monthly journal made up of articles on athletics and advertisements in about equal proportions.

The Laundry Guide, by W. J. MENZIES, referred to in our last issue, is published by McCorquodale & Co., Newton-le-Willows. Price 6d.

Miscellanea.

WE hear that the delay in the issue of the current number of Mr. F. G. Heath's "Fern Portfolio" has arisen wholly from the elaborate nature of the work and the great size of the stones employed in the colour-printing.

AMONGST the prominent Americans expected in London this month (says our chatty and readable contemporary *Society*) is the celebrated astronomer Dr. Draper, who will be accompanied by his fascinating wife, one of the most charming of American women, as accomplished as an Italian of the sixteenth century and as brilliant as a Parisienne of the eighteenth.

SHAKESPERIANA.—To the July part of the "Miscellanea Genealogica" Mr. Stephen Tucker, Somerset Herald, has communicated a most interesting account of the Assignment of Arms to the father of the poet. This account is illustrated by five *fac-similes* of documents from the Heralds' College Records. These have been most carefully executed in photo-lithography, and will be heartily welcomed by all those interested in Shakesperiana.

VIVISECTION.—During the year 1883, according to the annual report just issued to Parliament, five hundred and sixty-nine experiments were performed on living animals in the United Kingdom, thirty-four of these being carried out in Ireland. Fifty-five experiments were performed without anæsthetics, and one hundred and twenty-two under certificates giving permission to preserve the life of the animal after recovery from anæsthesia. Concerning this last class of experiments, the report states that in one hundred and fourteen cases the operation consisted of inoculation with various septic matters or morbific organisms, for the greater part connected with an important inquiry into the nature of tubercular affections. No pain was inflicted in these cases except in about fourteen or fifteen instances, in which disease was produced, but which was very trifling. In the remaining eight cases, in which more serious operations were required, as these were effected under anæsthesia, the only suffering in the animals that survived would be that which attends the ordinary repair of a "surgical injury."—*Medical Press and Circular.*

THE APRIL EARTHQUAKE.—Swiftly as the shadow of a summer cloud sweeps over wide country tracts, so glided by the invisible power, and ruins marked its course. When the actual active force of the calamity had come and gone, then terror had its turn. A mighty fear overcame most living things. Birds flew wildly hither and thither, uttering sharp, startled cries. Beating in blind haste, perhaps, against trees or walls, many a little feathered victim fell lifeless to the ground. A flock of sheep being driven up a hill-side could with difficulty be kept together, and one poor woolly matron died within a few minutes of the shock—her fate being shared by two lambs of very tender age. Farmyard fowls huddled together in abject fright. Dogs howled and cowered in amazement. Cottage folk tell almost unanimously, how they "wholly looked to be swallowed up!" And as for the womankind, rushing terror-stricken out of their falling homes, it seems that with one accord, to use their own emphatic phrase, "they shruck." "'T must be London blown up!" was one man's scared suggestion; but "Nay, mate," made answer a more reasoning mind. "Not if all London *was*

blown up 'twouldn't shake we like this. It's something wuss!" And for the panic that ensued, all who, like the writer, have made a pilgrimage through only part of the afflicted district, must own there is ample reason."—"*Cassell's Family Magazine*" for July.

WE are glad to notice conspicuous examples of boldness among our lay contemporaries in their discussion of and dealing with the burning question of vivisection; notably, the *Illustrated London News* recently devoted a whole page of matter and illustration to the humane and deeply interesting experiments of Pasteur, whose efforts to prevent human suffering and save human life are so well known as beyond all praise. At any rate they are far beyond the hysterical howlings of the class of the Cade and Jesse school, and of whom the *Dispatch* writes:—"We should remember that the sufferings of men and women are quite as acute, and accompanied with more mental anguish, than those of the inferior animals, and, no longer confining our sympathy to dogs and cats, we should take care that nothing in our Statute-book lessened the chance of alleviating human pain and lengthening the duration of healthy lives. The subject of wanton cruelty either to dumb animals, or children, or helpless women, should be legislated for on totally different grounds from those on which we proceed in the case of useful scientific experiment. It is an insult to include amongst the possible occurrences of such a crime the work of a great physiologist seeking the discovery of new truths. The Act of 1876 has resulted in almost extinguishing original physiological research in this country. This must be recognised by the thoughtful politician as a very great cruelty to present and future human beings suffering from diseases as yet but little understood."—*Medical Press and Circular.*

RUNNING AWAY FROM A RUNAWAY ENGINE.—A curious and very nearly a disastrous collision occurred on the Rock Island and Peoria Road recently. The engine of a gravel train got off the track near Coal Valley, a station about fourteen miles from Rock Island. A wrecking train was sent out from Galva to get the engine on the track again. Passenger train No. 2, going to Peoria from Rock Island, met the disabled engine first, and after considerable work the track was cleared. The train then started on, but had not got far, when the wrecking train was met on a sharp curve, the engine to which was backing up. Both engines were reversed as quickly as possible, but the trains came together with quite a shock. The passengers were badly shaken up, but no one was seriously hurt. The engineer and fireman of the engine attached to the wrecking train had jumped to the ground, and when the collision occurred the tank became detached, while the rest of the engine started forward at a terrific rate, the engineer having pulled the throttle wide open before he jumped. Passenger train No. 1 from Peoria was about due as the wild engine started down the track directly towards it. Both engines, however, approached on a straight track, and the engineer on the passenger train reversed his engine and started on the back track, closely followed by the wild engine. The chase was kept up for several miles, until the steam finally gave out on the runaway engine, and it was captured. Thus two narrow escapes from a fearful collision occurred in a short space of time.—*Railway Review* (Chicago).

WEIGHTS AND MEASURES CONFERENCE.—One of the latest organisations formed for the purpose of furthering the knowledge of the public on scientific and technical subjects is that known as the British Association of Inspectors of Weights and Measures, whose annual conference opened in Glasgow on Tuesday of the present week, Bailie Fullarton, of Greenock, presiding at the first sitting. One of the subjects discussed was embodied in a resolution proposed by Mr. Walker, of Glasgow. In that resolution the Association respectfully submitted to the Board of Trade that they did not consider it at all necessary, and certainly not desirable, that a new standard weight of 112 lb. should be legalised, and for the reasons that it was so near in size to the central or 100 lb. weight, and in consequence liable to be used fraudulently; that any on requiring such a large weight could use the already legalised central; that if a concession was to be made to one business the Board of Trade could not consistently refuse to grant a special weight to any other business; and that the concessions asked for by the ironmasters, if granted, would destroy the main principle of the Weights and Measures Act of 1878. Mr. Walker stated that there were already ninety-four standard weights at present in use. The secretary of the Association, Mr. Wimhurst, Manchester, dealt with the inspection of the weights and scales used in post-offices, which was considered to be not only desirable but absolutely necessary for the protection of the public. Mr. Pickering, of Sunderland, drew attention to the vagaries which distinguish the manufacture and stamping of ordinary commercial weights, and at the afternoon sitting of the Conference Mr. Shaw, of Edinburgh, read a paper entitled "Observations on the Weights and Measures of Apothecaries and the Necessity existing for Exactness, and for Comparing and Verifying the Same."—*Engineering.*

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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SAVAGE NAMES.

[1331]—The superstitions about names mentioned by Mr. Clodd (KNOWLEDGE, June 27) were shared by the Aryans of India. I am many miles from a copy of a Brahmana, but, either in the Aitareya or the Satapatha Brahmana, we find that Indra had a name which (like Mr. Clodd's savage friend) he would not divulge. When Indra fled after the slaying of Vrittsa (as Apollo fled after slaying the Python), he was in such an abject fright that he dropped his name from his lips involuntarily. In other respects, the results of his terror were exactly like what Odin experienced when he flew away with Suttung's mead. A. LANG.

COLOURS OF CLOUDS.

[1332]—I should feel obliged to any of your readers who would give a satisfactory explanation of a singular appearance which I witnessed one afternoon last week, and which I can remember to have noted on several occasions in past years, though not, I think, recently. The day was one of especial clearness and beauty, with a gentle breeze from W. or N.W., and scarcely a cloud, except a few of light texture and very small dimensions, floating at a low elevation near the N. horizon. There was nothing remarkable about these except their peculiar colouring, which was of a brownish grey, as though they had lain in shadow instead of being in the fullest solar illumination. One of rather greater dimensions and apparent consistency showed a whiter and more luminous centre, but its edges in every direction, above as well as below, were of the same sombre tint as its neighbours. I must confess my inability to understand how the vapour of water, which under ordinary circumstances is only visible by its pure white reflection, should assume so shadowy a hue, though perhaps the difficulty is no greater than that presented by the coppery tone frequently exhibited by portions of a thunder-cloud. T. W. WEBB.

ACARINA AND *ORIBATIDÆ.*

[1333]—Mr. Slack's very pleasant and interesting little article on the *Ixodidæ*, in your number of June 27, contains an error which I may as well correct, although it is probably a mere slip of the pen, because it might mislead others who are not so well acquainted with the organisation of the *Arthropodæ* as the author of "Pond Life" is.

In the article in question I am credited with doubting the respiratory functions of the so-called stigmata of the *Acarina*, and with supposing them to be sense-organs. This would be correct if the word *Oribatidæ* were substituted for *Acarina*, but my observations are confined to the *Oribatidæ*, and do not apply to any of the other numerous families of *Acarina*. It must not be supposed that I, for a moment, deny that the *Oribatidæ* possess stigmata, like other tracheate creatures; all I assert is that the conspicuous organs on the dorsal part of the cephalo-thorax of these tiny beings are not the stigmata, and are not connected with the tracheæ, but that these are sense-organs, and that the real stigmata, from which the tracheæ arise, are situated in the acetabula (basilar cavities) of the legs. ALBERT D. MICHAEL.

TESTS OF DIVISIBILITY.

(A reply to the general question involved in Letter 1274.)

[1334]—To determine whether a number (N) is divisible without remainder by another number n (n being any number prime to 10).

1. Divide 999 . . . . by n until there is no remainder. It can be algebraically proved that this will happen when $(n-1)$ 9's have been used. In practice a smaller number will often be found sufficient. For instance, if $n=41$, only *five* 9's are needed, $\left(=\frac{n-1}{8}\right)$.

2. Count the *number* of 9's used in the division, and mark off N in periods of the *same* number of figures, commencing from the right.

3. Add the periods together, marking off and adding again if the number of figures in the sum exceed the proper number in a period.

3A. When the period consists of an *even* number of figures, mark off the sum just obtained into *semi-periods*, and subtract one from the other. (This is in principle the same thing as the rule in Letter 1274, where alternate semi-periods are added in the first place, but I think my method will be found a little shorter in practice.)

4. Divide the final result in 3 (or 3A) by n. If there be no remainder, N is divisible by n. W.

PROPERTY OF NUMBERS.

[1335]—Thank you for publishing the problem under the above title (1295, p. 424), which if not difficult is novel and interesting. I solve it as follows:—Let the remainders upon division by 3, 5, 7, and 11 be t, f, s, and e, respectively, then the number is $385t+231f+330s+210e$, less such a multiple of 1155 as must be subtracted to reduce the number to one of three figures. It is evident that a number expressed by the above formula will divide by each of the divisors with the given remainder, and that no other number will do so unless the difference between it and this number is divisible by 3, 5, 7, and 11, that is, is a multiple of 1155.

It is easy to construct formulas for similar problems with different divisors. A limit must be fixed so that the number shall not exceed the product of all the divisors. [And the divisors must have no common factors.] Then the co-efficient of each remainder must be a number which divides by the divisor, producing that remainder with 1 remainder, and by all the other divisors without remainder. If the divisors were 7, 11, and 13 the co-efficients would be 715, 364, and 924.

The principle of this problem suggests to me a trick to be played with cards, as follows:—

Mix together two whole packs of cards and request some one to cut the double pack into two portions, and to divide one portion into seven equal packets, adding the superfluous cards, if any, to the other portion, then leaving the seven packets to divide the other portion into five equal packets, handing any superfluous cards to the performer of the trick, then mixing the five packets to divide again into three equal packets, again handing any superfluous cards to the performer, who will thereupon state how many cards are contained in each of the three packets and in each of the seven packets. Perhaps some of your readers may like to search for the solution of this trick. ALGERNON BRAY.

New York, June 18, 1884.

AN ANIMAL ATTEMPTS SUICIDE.

[1336]—Did not the poor animal referred to in letter 1308, already suffering from heat, and smoke, and fright, mistake the broken glass for ice or water, and carry it to its mouth with the hope of relieving its sufferings, rather than with the idea of suicide? M. J. C.

COINCIDENCES, &c.

[1337]—Most people have heard of the "War Office Ghost," the story of which is given in "Footfalls on the Boundaries of Another World,"—how the wife of an officer who was killed at Sir Colin Campbell's relief of Lucknow saw him at Cambridge the night of his death, and thereby detected an error of one day in the date as given in the official returns. Now, in the published account it is mentioned that he appeared to her with his shirt-front stained with blood, but it is most unusual for an officer in regimental uniform to show any shirt front at all. It happens, however, that shortly before his death he had a fancy patrol coat made, the front of which was cut open, showing a great deal of linen. I had been with him at Cawnpore a week or two before he was killed, and particularly noticed this. It would seem as if his wife actually saw him in the very dress he was killed in, without having previously been aware of the peculiarity of that dress. By-the-bye, it should have been stated at what hour of the day he was killed, so as to allow for difference of longitude. Thus, if his death happened at 8 a.m. his wife ought to have seen him between 1 and 2 a.m.

MUSAFIR.

[1338]—On Saturday, June 7, I had been writing to a young lady, on her death-bed, as it proved. I had finished my letter a few moments before one o'clock. Just at this moment she awoke from a dosing sleep. She called her sister, and asked her if she had been writing a letter to her. She replied she had not. "Then," replied the dear girl, "if you have not Mr. W—— has, and he has blotted it in two places." She died early on the following Monday morning, between three and four a.m. About ten a.m. that day my letter arrived, and on the first sheet, sure enough, there were two blots. This had occurred by a little accident, and I had not time to write a second letter. G. WATSON.

LETTERS RECEIVED AND SHORT ANSWERS.

E. L. GARBETT. Woe is me! that ever I admitted your Noah's rainbow letter. It has brought me not only about a ream—more or less—of controversial matter, but your own prodigious reply to my short comments in your last. The discussion must close, or else a whole number must be given up to it—which I must respectfully decline to suffer. No doubt, comets are very numerous (albeit Kepler was scarcely an authority on this point), and we must have run into or through plenty, as we shall do over and over again, without producing the slightest sensible effect upon the earth—beyond, perhaps, the apparition of a rather finer shower of shooting stars than usual. You should know more of the rudiments of Logic than to assume that aqueous comets must be held to exist until the contrary is proved. It would be quite as rational for me to assert that the inhabitants of Venus eat pork chops on a Friday, as you cannot prove the contrary! A. B. C., and R. LAING.—As you will see from the preceding reply, the Noah's Rainbow and Flood discussion is closed.—F. W. HENKEL. I am sorry that my decision to stop the Flood discussion excludes your really valuable and important communication.—A. GOODALL. Your letter to the publishers was considerably delayed, thanks to its being addressed to the Editor.—J. You must read KNOWLEDGE with very little attention, or you would know that theology is rigidly excluded from its columns, and your own letter is a theological one pure and simple. Acquire some rudimentary idea of what *evidence* is from Mill's "Logic," or any similar work.—H. P. DEANE and S. MACKIE. Thanks; but I was many miles away from South Kensington on July 2.—D. M. Your letter on "Tricycle Tracks" is very much longer than the interest of its subject warrants.—PROTEA. The black disc of Venus herself forming the base of the shadow cone, how can you possibly expect to see her shadow in any degree "sideways" during her transit either at ingress or egress? Why, the whole diameter of the sun is little more than half a degree. Besides, upon *what* do you suppose the shadow would be projected, even were we looking (as it were) edgeways at the whole arrangement? The latest edition of my "Transits of Venus" was published in 1878. I know of no other work covering the same ground. My lectures are always announced in KNOWLEDGE, but I have ceased for the present to deliver them.—E. PINFOLD and W. COOMBER. Your letters have been needlessly delayed owing to your omission to address "the *Chess* Editor."—DEPRECIATION. Mr. Wyman regrets that he has received no actuarial training.—T. MURRAY. The "P. D." theory is Pure Drivel, neither more nor less. Pray do not waste your time in sending me expositions of it; they one and all find their way immediately into the waste-paper basket.—T. MANN. "Polyglot's" article could not have been written to enable all his readers to dispense with the services of a patent agent, inasmuch as it points out that in complicated cases such aid is indispensable. Can you refer me to the number and page of KNOWLEDGE in which the statement to which you refer occurs?—HAROLD ROWNTREE. Sorry that the compositor should have taken liberties with your name. Thanks for your description of the approximate trisection of an angle; but, as in the case of nineteen-twentieths of the communications I receive, it is too long for insertion.—JAMES CRAM. I have received a "magic cube" from this gentleman which is really a marvel, and worthy of notice by all interested in what may be called numerical tricks.—A. G. PULLEE. I am away from my books where I write, but will look up my authority on my return.—W. COMMON. The change, *if* made at all, would be made in longitude 180°; but it is not a practical matter, as all civilised races may be held to be comprised between such limits of longitude, that while it is noon at Greenwich on, say, July 11, it is 3h. 40m. a.m. of the

same day at Vancouver Island, and 11m. 38m. p.m. at Wellington, New Zealand. Ships returning from circumnavigation of the world of course change their day on coming to the first port within these meridians.—WILLIAM WIGAN. I regret that I am powerless to help you.—DRUM sends a newspaper cutting of the score of a cricket match between two towns named Lennoxvale and Adelaide. In the first innings Lennoxvale scored 2 and Adelaide 4. The second was not played out. Seemingly the wicket soon ceased from troubling, and the weary were at rest.—PHOBOS. Depend upon it our contributor knows most thoroughly what he is writing about. I cannot conscientiously recommend you a cheap instrument. Neither of the gentlemen you name ever made a telescope in his life. I am quite uncertain about coming to town.—JULIA USHER. No telescope of less than 2½ inches in aperture is of the slightest use for astronomical purposes; and the lowest price at which a first-class instrument of this size is procurable is seven guineas, or thereabouts. I cannot undertake to recommend individual makers, of whom, by the way, there are very few; though sellers of telescopes abound.—O. P. As a really admirable introduction to the subject, nothing surpasses the "Marvels of Pond Life," by Mr. H. J. Slack, published by Groombridge & Son, London. For an exhaustive account of Cyclops, Daphnia, &c., see Dr. Baird's "Natural History of the British Entomostraca," published by the Ray Society. The "Micrographic Dictionary," published by Van Voorst, contains a mass of information concerning microscopic objects of every description—animal, vegetable, and mineral. For the adequate study of Infusoria proper, the "Manual of the Infusoria," by Mr. W. Savill, Kent, published by Bogue, London, must be consulted. The last two works named are both bulky and somewhat costly.—GERTY GIRTON. I do not insert your jeu d'esprit, just to show that I can resist temptation; but your P.S. put an amount of pressure upon me almost too great for even an editor to withstand.—ADA HEATHER BIGG. Your able paper unfortunately occupies more space than I could devote to a subject of comparatively limited popular interest.—JAMES GILLESPIE. My mere silence might have sufficed to indicate what I "think of" your pamphlet. I stand in a species of dumb amazement at any one who is so hopelessly ignorant of the most elementary facts of the subject, presuming to dogmatise upon them. I should no more dream of arguing with you than I should with a gentleman in a straight waistcoat who alleged that he was the Podasokus, or little Oozly bird. Any child of eleven who knows the principal constellations will tell you that we do *not* see the same stars in the September night sky that we do in the March one. Your prose is bad, your "poetry" verse and verse. As for letting you "know what you should do to bring it out," I would implore you, if you value your reputation, to keep it in, with all your might and main.—W. HILL & SON send a description of a "Hygienic Bakehouse," which would appear to present a delightful contrast to the filthy underground cellars in which Londoners have been from time to time shocked to learn that some of their bread is made.—W. P. THOMPSON BOULT. Your "New Patent Convention" received, but its great length precludes its insertion.—REV. T. W. WEBB. Received.—JOHN A. STEWART sends an account of the rescue of a man from a mine after three weeks' imprisonment, in consequence of a woman dreaming that he was immured in it. His entombment was quite unsuspected otherwise. This happened forty years ago.—T. A VLIGK (*sic*) takes exception to the statements on p. 9 as to the danger to be apprehended from disease germs.—J. F. O. I can only regret that the very great length to which your communication on "Fortune-Telling extends prevents its insertion, and I scarcely see my way to curtail it without destroying the sequence of your argument.

Our Mathematical Column.

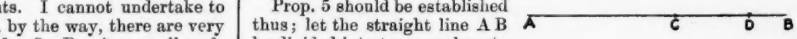
NOTES ON EUCLID'S SECOND BOOK.

By RICHARD A. PROCTOR.

IN the second book Euclid deals with the relations between the rectangles contained by straight lines and the parts into which they may be divided. The method he adopts is somewhat cumbrous—so far, at least, as Problems 2–10 are concerned. The student must not deal with problems on the second book in Euclid's manner. In order to illustrate the proper method of dealing with such deductions we give new solutions of Propositions 4 to 10, premising that Propositions 2 and 3 are particular cases of Prop. 1.

Euc. II., Prop. 4 should be thus established:—

Let A B be the given straight line divided into any two parts in the point C: the square on A B shall be equal to the squares on A C, C B, together with twice the rectangle A C, C B.



By Prop. 2 the square on A B is equal to the rectangle A B, A C, together with the rectangle A B, B C.

But by Prop 3, the rectangle A B, A C is equal to the rectangle A C, C B, together with the square on A C; and the rectangle A B, B C is equal to the rectangle A C, C B, together with the square on B C.

Hence the square on A B is equal to twice the rectangle A C, C B, together with the squares on A C and C B.

COR.—If a straight line be divided into two equal parts the square on the whole line is equal to four times the square on either half.

Prop. 4 may be enunciated thus, *If a straight line be divided into any two parts, the square on one part is less than the square on the whole line by twice the rectangle contained by the parts together with the square on the other part.*

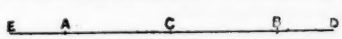
Prop. 5 should be established thus; let the straight line A B be divided into two equal parts in C, and into two unequal parts in D; then the rectangle A D, D B together with the square on C D shall be equal to the square on C B.

Since A D is made up of A C, C D whereof A C is equal to C B, the rectangle A D, D B is equal to the rectangle C D, D B together with the rectangle C B, D B (Euc. II., 1); that is, to twice the rectangle C D, D B, together with the square on D B (Prop. 3). Add the square on C D. Then the rectangle A D, D B together with the square on C D, is equal to twice the rectangle C D, D B together with the squares on C D, D B; that is, to the square on C B (Prop. 4).

COR. Since the square on A C or C B is equal to the rectangle A C, C B, it follows that if a straight line is divided into unequal parts the rectangle contained by these is less than the rectangle contained by the halves of the line; and also (the deficiency being the square on C D) that the more unequal the parts the smaller is the rectangle contained by them.

Prop. 6 should be established thus,—

Let the straight line A B be bisected in C, and produced to D; then the rectangle A D, D B together with the square on C B, shall be equal to the square on C D.



Produce D A towards A to E, making E A equal to B D, so that C E is equal to C D and B E to A D. Then by Prop. 5, the rectangle E B, D B together with the square on C B is equal to the square on C D; that is, the rectangle A D, D B together with the square on C B is equal to the square on C D.

Props. 5 and 6 may be included in one enunciation thus—*The rectangle contained by the sum and difference of two straight lines is equal to the difference of their squares* (A C, C D *being the two lines referred to*); *or thus, taking* A D *and* B D *as the two lines of reference, the rectangle contained by two lines is equal to the square of half their sum diminished by the square of half their difference.*

Prop. 7 is proved thus:—

Let the straight line A B be divided into any two parts in C; the squares on A B, B C, shall be equal to twice the rectangle A B, B C, together with the square on A C.

The square on A B is equal to the squares on A C, C B, with twice the rectangle A C, C B (Prop. 4). Add the square on C B. Then the squares on A B, C B are together equal to the square on A C, twice the square on C B and twice the rectangle A C, C B; that is to the square on A C together with twice the rectangle A B, B C (Prop. 3).

Prop. 7 may be enunciated thus:—*The square on the difference of two lines* (A B *and* B C) *is less than the sum of the squares on those lines by twice the rectangle contained by them.*

Prop. 8 is proved thus:—

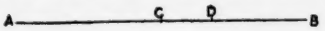
Let the straight line A B be divided into any two parts in C; then four times the rectangle A B, B C together with the square on A C is equal to the square on the straight line, made up of A B and B C together.

Produce A B to D making B D equal to B C, so that A D is the line made up of A B and B C together. Then the square on A D is equal to the squares on A C, C D together with twice the rectangle A C, C D. But the square on C D is equal to four times the square on C B (Prop. 4, Cor.) and the rectangle A C, C D is equal to twice the rectangle A C, C B (Prop. 1). Hence the square on A D is equal to the square on A C, together with four times the square on C B and four times the rectangle A C, C B; that is, to four times the square on A C and four times the rectangle A B, C B (Prop. 3).

COR.—If A C is equal to B C and therefore to C D, we have the

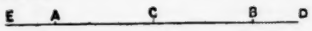
square on A D equal to the square on A C, and eight times the square on D C; that is, to nine times the square on A C. Hence if a straght line be divided into three equal parts, the square on the whole line is equal to nine times the square on any one of the parts.

Prop. 9 thus,—Let the straight line A B be divided into two equal parts at the point C, and into two unequal parts at the point D; then the squares on A D, D B are together equal to double the squares on A C, C D.



The square on A D is equal to the squares on A C, C D, together with twice the rectangle A C, C D; that is, the square on A D is *greater than* the squares on C B, C D by twice the rectangle C B, C D. And the square on D B is *less than* the squares on C B, C D by twice the rectangle C B, C D (Prop. 7, 2nd enunciation). Hence, adding the squares on A D and D B are together equal to double the squares on C B, C D.

Prop. 10 thus,—Let the straight line A B be bisected in C, and produced to D; then the squares on A D, D B shall be together double of the squares on A C, C D.



Produce D A to E making A E equal to B D; so that E C is equal to C D and E B to A D. Hence, by the preceding proposition, the squares on E B, B D are together double the squares on E C, C B. That is, the squares on A D, B D are together double the squares on C D, C B.

Props. 9 and 10 may be included under one enunciation thus,—

The squares on two lines (A D *and* D B) *are together double the squares on half the sum and half the difference of the two lines;*

or thus

The squares on the sum and difference of two lines (A C *and* C D) *are together double the squares on the two lines.*

COR.—Since the squares on A D, D B exceed the squares on A C, C B by twice the square on C D, it follows that when a straight line is bisected the sum of the squares on the two parts is least, and the sum is greater as the difference between the two parts of the divided line is greater.

(To be continued.)

EASY RIDERS ON EUCLID'S FIRST BOOK.

WITH SUGGESTIONS.

(Continued from page 19.)

149. If the opposite sides of a quadrilateral figure are equal the figure is a parallelogram.

150. If the opposite angles of a quadrilateral figure are equal the figure is a parallelogram.

151. The two straight lines A B, A C, intersect in A, and P is a point within the angle B A C. It is required to draw a straight line B P C so that B P may be equal to P C.

Suppose B P *equal to* P C; *join* A P *and produce to* D *so that* P D *may be equal to* A B. *Then* A B D C *is a parallelogram, &c.*

152. With the same construction, Q is a point without the angle B A C. It is required to draw Q B C so that Q B may be equal to B C.

Take a point E *in* A B *produced, so that* B E *may be equal to* A B. *Then* Q E C A *is a parallelogram (if* Q B *be assumed equal to* B C.

153. From a given point in one of two intersecting lines it is required to draw a line terminated by the second, and such that the line drawn from the point of intersection of the given lines to the bisection of the required line may make given angle with one of the given lines.

154. From a given point P it is required to draw three straight lines P A, P B, and P C equal respectively to three given straight lines, and having their extremities A, B, and C in one straight line and A B equal to B C.

Suppose the lines drawn as required P B lying between P A and P C; then if P B be produced to D so that B D is equal to P B, P A D C is a parallelogram, &c.

155. Draw a straight line through a given point such that the part of it intercepted between two given parallels may be of a given length.

156. Draw a straight line through a given point lying between two parallels, so that the line may be terminated by the parallels, and divided by the given point into two parts having a given difference.

157. If the diameters of a quadrilateral figure bisect the angles the figure is a rhombus.

158. If one diameter of a parallelogram bisect opposite angles it is a rhombus.

159. If the diameter of a parallelogram intersect at right angles it is a rhombus.

160. Straight lines bisecting adjacent angles of a parallelogram intersect at right angles.

161. Straight lines bisecting opposite angles of a parallelogram having unequal sides are parallel to each other.

162. If the diameters of a parallelogram are equal it is a rectangle.

163. If the diameters of a quadrilateral figure bisect the angles and are equal the figure is a square.

164. Find a point such that the perpendiculars let fall from it on two given straight lines may be equal to one another.

165. Between two given straight lines draw a straight line which shall be equal to one straight line and parallel to another.

166. On A B a side of the parallelogram A B C D a parallelogram A F E B is described, so that E B is in the same straight line with B D, and F B with B C. Show that E B is equal to B D.

167. Equilateral triangles are described on the four sides of a parallelogram.

168. On A B, D C opposite sides of a parallelogram, equilateral triangles A B E and C F D are described towards the same parts; show that F E A D and F E B C are parallelograms.

169. If in Ex. 168, C F D and A E B are described towards opposite parts, then D E B F and C E A F are parallelograms.

170. From A, C, opposite angles of the parallelogram A B C D, are drawn the four lines, A F, A E, C G, C H, perpendicular respectively to the sides A D, A B, C B, and C D, and on the side remote from the parallelogram; also A F is equal to C G, and A E to C H. Show that E G H F is a parallelogram.

171. Equilateral triangles are described on the four sides of a parallelogram. Show that the vertices of these triangle fall on the angles of a parallelogram,—

(i.) When all the triangles are towards the same parts as the parallelograms.

(ii.) When all the triangles are towards opposite parts.

(iii.) When two triangles on opposite sides are towards the same parts, and the other two triangles towards opposite parts.

172. On the sides A B, B C, and C D of a parallelogram A B C D three equilateral triangles A B E, B C F, and C D G are described, A B E and C D G towards the same parts as the parallelogram and B F C towards opposite parts. Show that E F and F G are respectively equal to two diagonals of the parallelogram.

Show that the triangle B F E *is equal in all respects to the triangle* A B C.

173. Show that the same holds good if B F C lies towards the same parts as the parallelogram and A B E, C D G, towards opposite parts.

174. In the parallelogram A B C D, the angle A D B is equal to the angle A C B. Show that A B C D is rectangular.

(To be continued.)

Our Chess Column.

BY MEPHISTO.

CHESS GOSSIP.

A TESTIMONIAL is now being raised for England's Chess Champion, Mr. Blackburne, who has recently undergone a severe illness.

The *Field* devotes a leading article in discussing the desirability of having a National Chess Association. That such an institution would benefit the cause of Chess goes without saying.

The same writer condemns the proceedings of the Counties Chess Association. It is quite unworthy of amateur Chess players to appeal to the public for funds, and at the same time exclude those players in whose performances the public take the most interest.

We are afraid the secretary betrayed the weakness of his cause when he thought desirable to put forth the names of MacDonnell and Bird as likely competitors, with a general promise to admit first-rates. It may also be reckoned a very clever move to exclude first-rates, after once having attracted the notice of the public by the bait.

The following story, which comes from an eye-witness, may throw some light upon the matter.

Scene: a meeting of the Counties Chess Association. A prominent member of C.C.A. playing with a fairly strong player from London. Prominent member, being in difficulties, takes half an hour to consider his move. Time limit twenty moves an hour. London player politely (but with just a suspicion of sarcasm): "Your sand is running out, sir." Prominent player of the C.C.A.

(who sees a way out of his difficulties) to London player *most severely*: "It is very rude, sir, to make any remarks. The fact is, sir, you are a professional player, and I shall not play with you any more."

London player is given £5 to go home, and prominent player and supporter of the C.C.A. wins sundry prizes.

A Mr. Miller has stated in the press that Morphy could have given Zukertort a Knight. On his visit to Cincinnati, Zukertort meets this Miller at a large party, and plays with him ten games, winning every game. Says the champion, within hearing of the company: "A namesake of yours has declared that Morphy could give me a Knight! do you think so?" Collapse and discomfiture of Miller.

We wonder whether this is the same Mr. Miller who has taken upon himself the inglorious task of reprinting the third edition of Cook's "Synopsis." Has he asked the author's permission?

Besides, as a fourth edition of the "Synopsis" is in the press, and Mr. Marriott has, likewise, a useful book all but printed, we would warn the American public against making a useless investment, and keep their money for the fourth edition, which we hear will be a great improvement on the third.

A BRITISH CHESS ASSOCIATION.

In an ably-written leader in the *Field*, the writer advocates the establishment of a British Chess Association, to take the place of and supersede the Counties Chess Association. That which strikes me as being the most important consideration seems to have been quite overlooked in the arguments in favour of the scheme; for to attempt for one moment to draw comparison between Chess and other sports, is to assume, *prima facie*, a false standpoint altogether. Although the number of devotees to the noblest and most fascinating of games is undoubtedly on the increase, the fact cannot be denied that all outdoor sports, inasmuch as they are easily appreciated by the masses, besides being healthy and exhilarating, will, as long as the world stands, command a far greater patronage than Chess.

It is, therefore, open to doubt whether, even with the assistance of Royal patronage, the necessary constant supply of funds will always be forthcoming for carrying out the annual tourneys and prize competitions projected.

The consummation of the project, however, would, I am sure, be hailed with delight by all British Chess-players, amateur and professional alike. In the interest of the Royal game, it is sincerely to be hoped that it will be a success. All players will then undoubtedly welcome the Chess Editor of the *Field* as the "Mahdi" of Chess.

BOREALIS.

THE RUY LOPEZ (*continued from page* 419).

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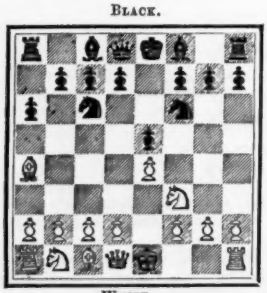

WHITE.

If in this position White plays 5. P to Q4, Black can arrive at a position already dealt with:—

5. P to Q4	5. P × P
6. P to K5	6. Kt to K5
7. Castles	7. B to K2
8. R to Ksq	8. Kt to B4
9. B × Kt.	9. QP × B
10. Kt × P	10. Castles,

with a safe game.

Should White play 5. Kt to QB3, Black may continue with 5. B to Kt5, followed by Castling, and the positions will be fairly equal.

The strongest although the least attacking continuation is 5. P to Q3. This move will be found in many games of the London Tournament. This move brings about a struggle for position only, and is, therefore, more suited for match play than for ordinary practice. By P to Q3 White protects his own Pawn and threatens B × Kt, followed by Kt × P. Now the question is which way best to defend the KP. Q to K2 would, of course, not be a good move; there remains, therefore, only 5. P to Q3. In this case, however, Black's KB will only find development by way of P to KKt3, while the white KB will be well placed either on Kt3, or if P to QB3 has preceded, on B2. The disadvantage of Black's position is somewhat similar to the Philidor defence. Having indicated the general principle of this opening, we do not think we need give any particular variation, as White has nothing to do but to develop his game. It is a thoroughly reliable opening.

No solution having reached us of Mr. Carpenter's Problem, we defer the solution till next week.

During Dr. Zukertort's stay in New Orleans, he contested altogether twenty-two games with Mr. Jas. McConnell, of which the doctor won fourteen, lost five, and drew three.

The last game between the players during Dr. Zukertort's visit, at New Orleans, May 12, 1884:—

PHILIDOR'S DEFENCE.

White. Mr. Jas. M'Connell.	Black. Dr. Zukertort.	White. Mr. Jas. M'Connell.	Black. Dr. Zukertort.
1. P to K4	P to K4	13. Kt × QP	B to Kt2
2. Kt to KB3	P to Q3	14. Castles (QR)	P × P (*g*)
3. B to B4 (*a*)	Kt to QB3 (*b*)	15. Kt to K6(ch)!	B × Kt
4. P to QR3 (*c*)	P to KB4	16. Q × QP (ch)	K to Ksq
5. P to Q3	Kt to KB3	17. B × B	Kt to Q4
6. B to KKt5	P to KR3 (*d*)	18. Q to Q7 (ch)	K to Bsq
7. B × Kt	Q × B	19. B × Kt (*h*)	R to Qsq
8. Kt to QB3	Kt to K2	20. Q × KtP	Q to B5 (ch)
9. Kt to QKt5(*e*)	K to Qsq	21. K to Ktsq	B × Kt
10. Q to Q2	P to QB3	22. Q × BP!	B to B3
11. Kt to B3	P to KKt4	23. B × P	
12. P to Q4	P × QP (*f*)		

And Black resigns.

NOTES.

(*a*) A continuation favoured by Mr. Boden, but generally held inferior to 3. P to Q4. Of late, however, some strong players, notable among them Mr. Blackburne, we believe, have shown a predilection for the text move.

(*b*) 3. ** B to K2, introduced by Harrwitz in his match with Loewenthal, is more usual and apparently stronger.

(*c*) Evidently to provide a retreat for the Bishop, should the adverse Knight attack from R4; but 4. P to Q4 seems preferable either on this or White's next move.

(*d*) Here once again 6. ** B to K2 appears best.

(*e*) A well-timed advance. White has now secured a marked advantage in position.

(*f*) Would not 12. ** Kt to Kt3, instead, have been a much stronger reply?

(*g*) Too covetous by half, and seemingly quite unprepared for the pretty stroke of play with which his opponent at once replies.

(*h*) Even 19. Kt × Kt would have been safe, for Black had nothing but a few unavailing checks. Indeed, the latter's game has been most seriously compromised, if not defenceless for some time past.—*Times Democrat.*

ANSWERS TO CORRESPONDENTS.

****** *Please address Chess Editor.*

The Owl.—We regret to say that Problems are not suitable. The Problem cannot be done in two moves.

Mrs. H. W.—It is desirable that all variations should be given in a solution. Solution correct.

A. W. Overton.—Solution of above Problem correct.

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